



Acerca de este libro

Esta es una copia digital de un libro que, durante generaciones, se ha conservado en las estanterías de una biblioteca, hasta que Google ha decidido escanearlo como parte de un proyecto que pretende que sea posible descubrir en línea libros de todo el mundo.

Ha sobrevivido tantos años como para que los derechos de autor hayan expirado y el libro pase a ser de dominio público. El que un libro sea de dominio público significa que nunca ha estado protegido por derechos de autor, o bien que el período legal de estos derechos ya ha expirado. Es posible que una misma obra sea de dominio público en unos países y, sin embargo, no lo sea en otros. Los libros de dominio público son nuestras puertas hacia el pasado, suponen un patrimonio histórico, cultural y de conocimientos que, a menudo, resulta difícil de descubrir.

Todas las anotaciones, marcas y otras señales en los márgenes que estén presentes en el volumen original aparecerán también en este archivo como testimonio del largo viaje que el libro ha recorrido desde el editor hasta la biblioteca y, finalmente, hasta usted.

Normas de uso

Google se enorgullece de poder colaborar con distintas bibliotecas para digitalizar los materiales de dominio público a fin de hacerlos accesibles a todo el mundo. Los libros de dominio público son patrimonio de todos, nosotros somos sus humildes guardianes. No obstante, se trata de un trabajo caro. Por este motivo, y para poder ofrecer este recurso, hemos tomado medidas para evitar que se produzca un abuso por parte de terceros con fines comerciales, y hemos incluido restricciones técnicas sobre las solicitudes automatizadas.

Asimismo, le pedimos que:

- + *Haga un uso exclusivamente no comercial de estos archivos* Hemos diseñado la Búsqueda de libros de Google para el uso de particulares; como tal, le pedimos que utilice estos archivos con fines personales, y no comerciales.
- + *No envíe solicitudes automatizadas* Por favor, no envíe solicitudes automatizadas de ningún tipo al sistema de Google. Si está llevando a cabo una investigación sobre traducción automática, reconocimiento óptico de caracteres u otros campos para los que resulte útil disfrutar de acceso a una gran cantidad de texto, por favor, envíenos un mensaje. Fomentamos el uso de materiales de dominio público con estos propósitos y seguro que podremos ayudarle.
- + *Conserve la atribución* La filigrana de Google que verá en todos los archivos es fundamental para informar a los usuarios sobre este proyecto y ayudarles a encontrar materiales adicionales en la Búsqueda de libros de Google. Por favor, no la elimine.
- + *Manténgase siempre dentro de la legalidad* Sea cual sea el uso que haga de estos materiales, recuerde que es responsable de asegurarse de que todo lo que hace es legal. No dé por sentado que, por el hecho de que una obra se considere de dominio público para los usuarios de los Estados Unidos, lo será también para los usuarios de otros países. La legislación sobre derechos de autor varía de un país a otro, y no podemos facilitar información sobre si está permitido un uso específico de algún libro. Por favor, no suponga que la aparición de un libro en nuestro programa significa que se puede utilizar de igual manera en todo el mundo. La responsabilidad ante la infracción de los derechos de autor puede ser muy grave.

Acerca de la Búsqueda de libros de Google

El objetivo de Google consiste en organizar información procedente de todo el mundo y hacerla accesible y útil de forma universal. El programa de Búsqueda de libros de Google ayuda a los lectores a descubrir los libros de todo el mundo a la vez que ayuda a autores y editores a llegar a nuevas audiencias. Podrá realizar búsquedas en el texto completo de este libro en la web, en la página <http://books.google.com>



This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

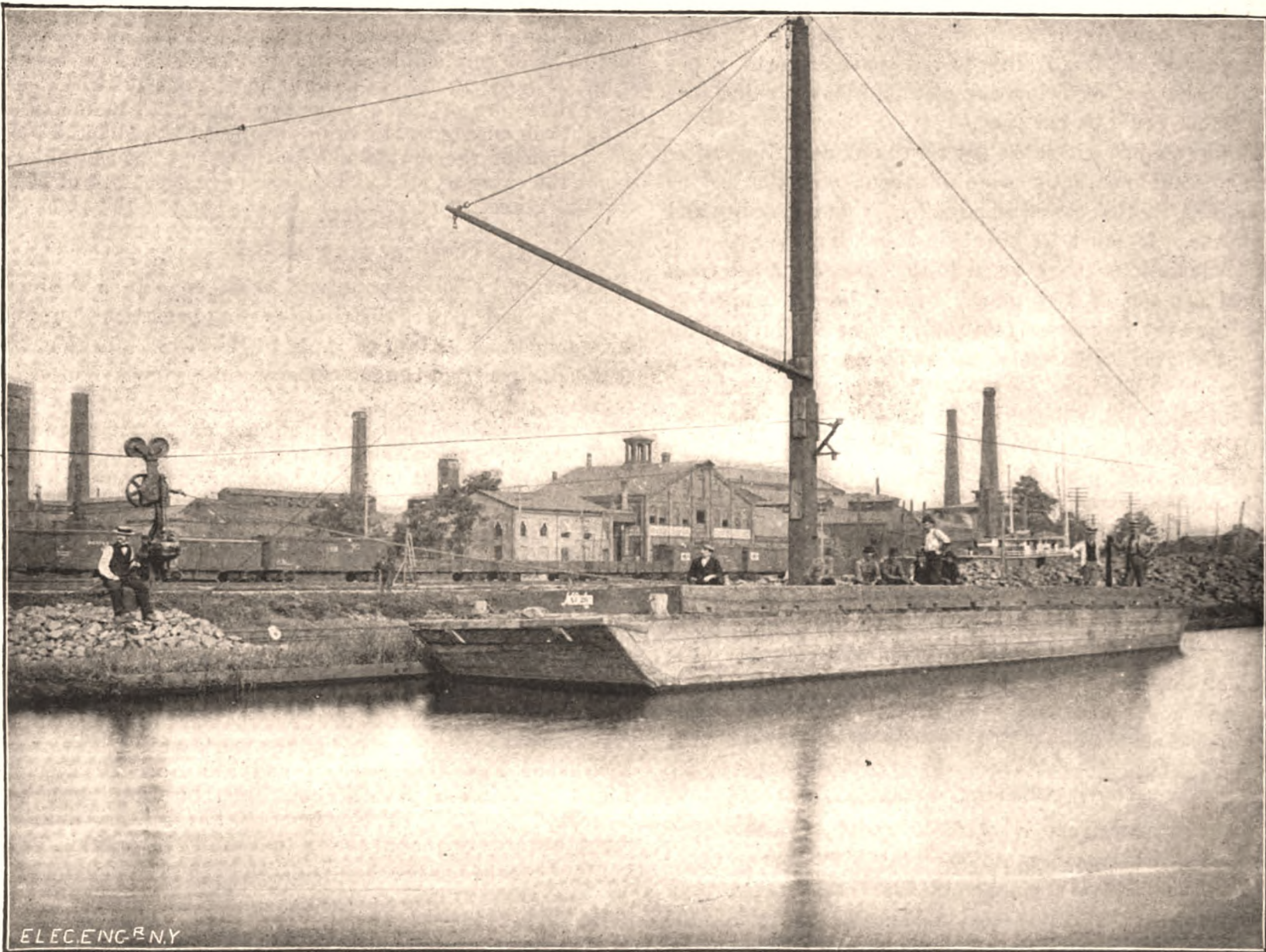
Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

- + *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.
- + *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.
- + *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.
- + *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at <http://books.google.com/>



Electrical engineer

9280
323
v.18 8

Library of



Princeton University.

THE Electrical Engineer.

Vol. XVIII.

JULY 4, 1894.

No. 322.

CURIOUS EFFECTS OF HERTZIAN WAVES.

BY

Shirley Thomson

IN the issue of the London *Electrician* of June 8, 1894, under the heading, "Hertzian Waves at the Royal Institution," the following remark occurs: "It is wholly probable, as Dr. Lodge suggests, that Hertzian waves may often have manifested themselves in physical laboratories to the annoyance of the workers, etc."

I may mention in this connection that in 1877, if I remember the year correctly, while working a Ruhmkorff induction coil, one terminal of which was grounded and the other terminal of which was attached to an insulated metallic body, Prof. Houston and I noticed that when the sparks were passing between the terminals of the coil, it was possible not only to obtain minute sparks from all metallic bodies in the immediate neighborhood, that is, in the same room, but that delicate sparks could be taken by holding in the hand a small piece of metal near metallic objects in many other rooms and on different floors in the building, although the pieces were not connected to ground. These could only have been Hertzian effects, but there was no recognition of their true character at the time, though the effects were seen to be connected with the very quick charging and discharging of the insulated body. An account of these experiments was, I think, published in the *Journal* of the Franklin Institute at the time.

I desire also to mention, as coming under my notice within the past year, a curious and rather amusing illustration of the principle upon which the beautiful instrument for detecting the presence of electric oscillations devised by Dr. Lodge and called by him the "coherer," is based.

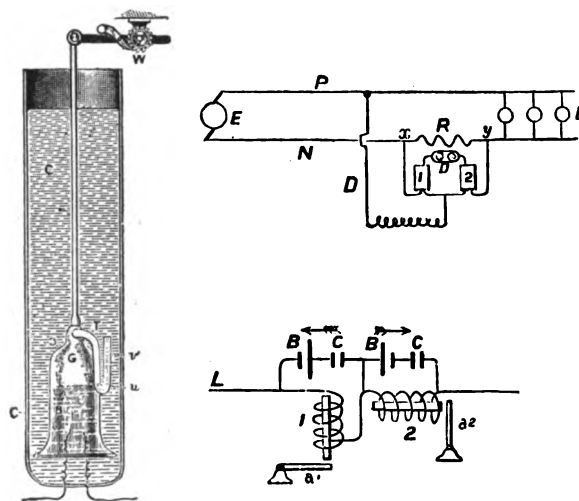
It was reported to me when in Philadelphia that a certain electro-plater had found that he could not pursue his silver plating operations during thunder-storms, and that if he left his plating over night and a thunder-storm came up the work was invariably ruined. I was disposed to be thoroughly skeptical, and expressed my disbelief in any such effect. Being urged, however, I went to the silver plater's shop, which was a small one, and questioned the silver plater himself concerning the circumstance which had been reported. While it was evident that he was not a man who had informed himself electrically, I could not doubt that, after conversing with him, he had indeed been stating what was perfectly true; namely, that when his operations of plating were going on and a thunder storm arose, his batteries, which were Smee cells, acted as though they were short-circuited, and the deposit of metal was made at too rapid a rate. The secret came out on an inspection of his connections. The connections of his batteries to his baths were made through a number of bad contacts which could not fail to be of high resistance under ordinary conditions. I could readily see that virtually he was working through a considerable resistance and that he had an excess of battery power for the work. Under these circumstances a flash of lightning would cause coherence of his badly contacting surfaces, and would improve the conductivity so as to cause an excessive flow of current,

give a too rapid deposit, and—as he put it—"make the batteries boil."

The incident suggests the use of Dr. Lodge's ingenious instrument in the study of the waves which are propagated during thunderstorms, of which waves we have practically little or no information.

THE WATERHOUSE ELECTROLYTIC METER.

The Waterhouse Electrometric Syndicate, of London, has recently introduced into England the interesting electrolytic meter shown in the accompanying illustrations, which possesses some distinctly novel features. The electrolytic cell of the meter is shown in Fig. 1. The electrodes are two coils of platinum wire, and the electrolyte is a 12 per cent. solution of sulphuric acid. The mixed gases are collected in the glass bell-jar B, which is fitted with an inverted syphon-tube T. The gases accumulate



FIGS. 1, 2 AND 3.—THE WATERHOUSE ELECTROLYTIC METER.

until they force the fluid down to the bend of the U-tube, when they escape, leaving the collector ready to collect another charge of gas. The rise and fall of the bell-jar in the glass cell actuate a ratchet wheel, and the motion is recorded by a series of dials and pointers.

The latest arrangement of the meter circuit is shown diagrammatically in Fig. 2; here E is the source of energy, P and N the positive and negative mains, respectively, D a derived circuit of about 1,200 ohms leading to the meter, L the lamps, and R the portion of the main circuit with which the meter circuit is placed in parallel. When no lamps are alight a special device, not shown, breaks the derived circuit, completing it as soon as one lamp is turned on. If we assume the derived circuit D to be complete but no current to be flowing in the mains, the derived current will divide equally between the two electrolytic cells 1 and 2, the floats of which work the dial in opposite directions, so that nothing is registered. When, however, a current flows in the mains there will be a fall of potential between x and y proportional to the amount of current passing from the lamps. As the fall of pressure

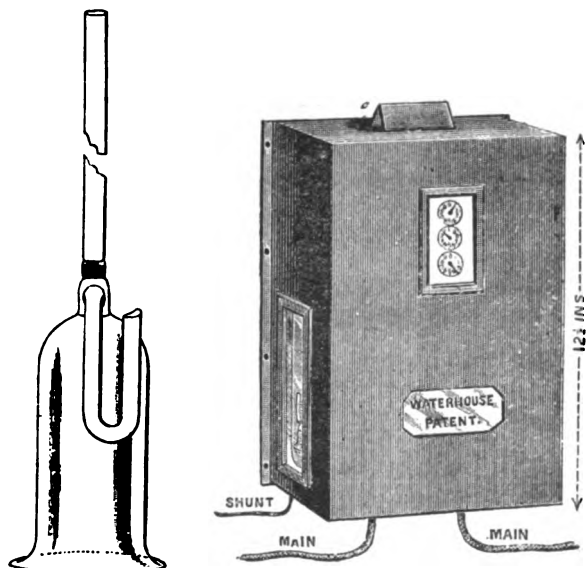
RECAP

9780
2238

922490

Digitized by Google

over R is limited by the London Board of Trade to 0.5 volt, while the counter electromotive force offered by the two cells is over 4 volts, it is evident that none of the main current will actually pass through the meter circuit, but, according to the difference of potential between x and y , a greater or less proportion of the total derived circuit current will be diverted through cell 1. The main current is thus measured indirectly by the varying proportions of a practically constant current which is sent through cell 1. In this way the necessity for maintaining by a system of carefully-adjusted resistances the exact proportionality at all temperatures between R and the meter circuit is avoided. A meter of this kind can be made extremely sensitive, since if the derived circuit is not broken, the minutest fall of pressure over R will have its due changing-over effect. The range also can be made indefinitely wide by reducing the value of R . The two branches of the meter circuit being of identical nature, and exposed to identical conditions, temperature effects, so far as resistance is concerned, cancel out, and the errors introduced by volumetric temperature effects are small within the ordinary limits, and easily compensated for. Ordinary changes in the voltage do not materially affect the indications, owing to the fact that, as the meter works differentially,



FIGS. 4 AND 5.—WATERHOUSE ELECTROLYTIC METER.

any change in the derived current will balance itself on both sides when no lamps are burning; and when lamps are put on, any increase in the derived current will reduce the changing-over effect, on account of the increased fall of potential over the meter circuit, and vice versa. Curves produced by this meter show it to be capable of considerable accuracy.

Fig. 4 shows the measuring bell, with the little siphon on its side. The vertical rod of glass is a guide, and to it is attached the recording mechanism. The gas collects in the bell, gradually floating it up, and as it fills with gas, the pressure increases within the bell, until it is sufficient to expel the water and acid solution round the lower bend of the siphon, and out by its vertical branch; the gas rushes out, and the bell falls by its own weight in the solution and turns the index train of wheels. The meter complete, and enclosed in its case is shown in Fig. 5.

The device is a neat and ingenious one, and probably as simple as could be hoped for in a meter of this class, and, if as accurate in commercial practice as the claims of the makers show it to be in laboratory tests, should make friends for itself readily.

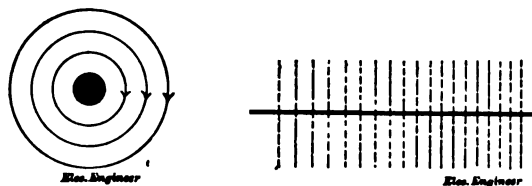
Mr. Waterhouse also proposes to apply the voltameter principle, so as to obtain non-wasteful shunts, safety shunts

for series motors run on constant current circuits, etc. In Fig. 3 is shown an electrolytically polarized relay arrangement. When the line current is passing from left to right the path through the shunt battery B and electrolytic cell C is taken in preference to that through the high resistance coil 1, and the armature a' is left at rest, while a is actuated, while the opposite takes place when the current is sent along the line in the reverse direction.

A SIMPLE EXPLANATION OF THE POSSIBLE CAUSE OF SELF-INDUCTION.

BY RICHARD PFUND.

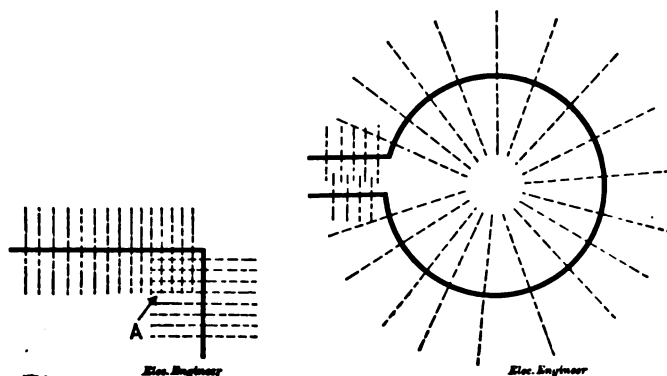
IN reading over Prof. Elihu Thomson's paper on "Magnetism in its Relation to Induced E. M. F. and Cur-



FIGS. 1 AND 2.

rent," read before the Am. Inst. of E. E., some years ago, it occurred to me that the phenomenon of self-induction, or electro magnetic inertia, noted when a conductor is bent out of a straight line, or coiled, can be very easily explained by assuming, as Prof. Thomson does, that the effect of the current is to open up, or stretch out, closed magnetic circuits, or lines, at right angles to the conductor, usually represented by concentric circles, as shown in Fig. 1.

If the wire is perfectly straight, (Fig. 2), the self-induction, or retardation, is small, being then merely due to the elasticity, or inertia, of the closed magnetic circuits, or atmosphere around the conductor; but if the conductor be bent or coiled (Figs. 3 and 4) the self-induction, or



FIGS. 3 AND 4.

retardation, will be enormously increased because the lines in opening up come into collision on the inside of the bend, as shown at A , in Fig. 3.

If the current rapidly varies in strength or direction, the effect of self-induction of course increases, because the collisions become more frequent; in fact, I can imagine that, at very high rates of change, the mere bending of a conductor would make it almost impassable, or opaque, to such a current.

MUNICIPAL LIGHTING PLANT FOR HAMILTON, O.

A vote has been taken at Hamilton on the question of issuing bonds for an electric light plant. There were 1,260 votes cast for the issuance of the bonds, and 609 against.

A NEW TYPE OF DYNAMOMETER.

BY

THE development of the instrument described below is due to a series of inaccurate readings obtained by the writer with a spring dynamometer during a test, but which fortunately were so inaccurate as not to mislead, although requiring a repetition of the test with another instrument.

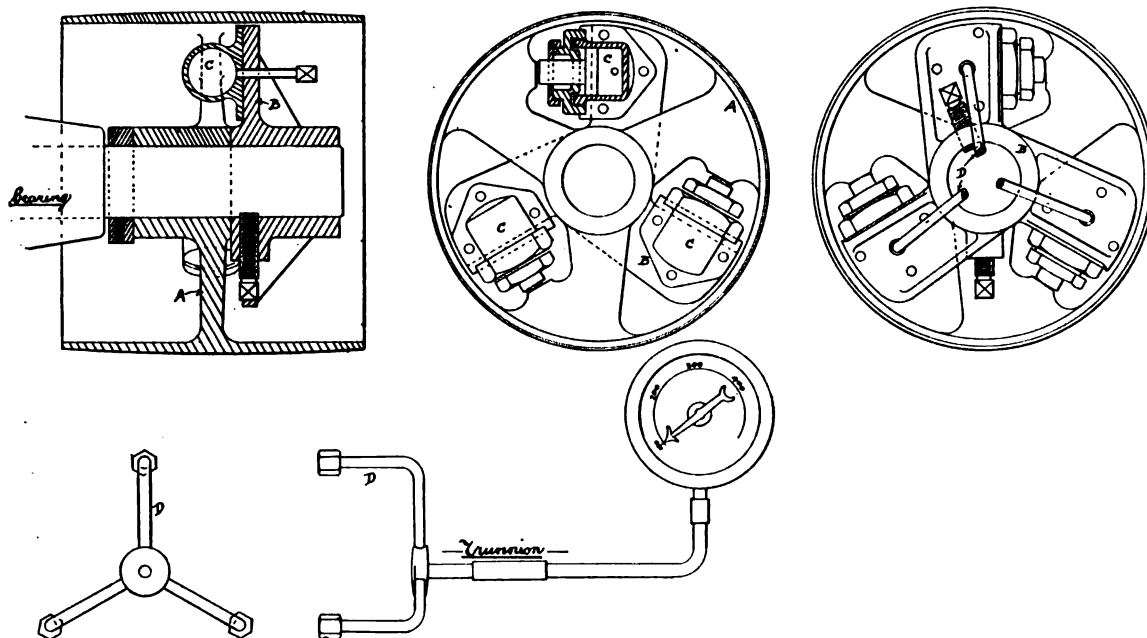
The main feature of the improved instrument is that instead of transmitting power through springs, a liquid is interposed between the two posts of the instrument. In dynamometers in which springs are employed to transmit the power, the necessary disposition of the posts of the instrument prohibit its being used on high speed shafting, necessitating the use of a countershaft and cutting up of belts, with the extra liability to error; but in the improved instrument these objections are eliminated, as it is not affected by speed, and there is no need of a countershaft, as it can be arranged within the diameter of an ordinary driving pulley; in fact, the original drawing showed an

from the cylinders to revolve with them, while the parts beyond the joint remain stationary. From this joint a pipe is led to a pressure gauge, which may be graduated in pounds, or for a standard speed in horse-power. The gauge may be located in any convenient place, and a series of instruments may be connected to one gauge. The cylinders and pipes are filled with a liquid, and the pressure exerted through the liquid is recorded by the gauge.

This instrument has numerous advantages; it is simple, it is not affected by the speeds of shafting in ordinary practice, it requires no countershaft, and no change of driving belt. It takes the place of an ordinary driving pulley, and is driven by the same belt. It may be connected to a recording gauge, and a continuous diagram of load obtained without attention. It does not have to be displaced after a test is completed, as by closing a valve the recording apparatus may be disconnected, if desired, and the remainder left in place, instead of the regular pulley.

CHANGE OF CONDUCTIVITY OF A SOLUTION BY THE ADDITION OF A NON-ELECTROLYTE.

MR. R. J. HOLLAND, in the *Ann. Phys. Chem.*, gives the following account of his general results. The electrical conductivity of a solution of an electrolyte in methylic alcohol diminishes on the addition of a non-conductor, the



THE CROSS SELF CONTAINED DYNAMOMETER.

instrument capable of transmitting 75 h. p. inside a pulley 21 in. in diameter and running at 1,000 revs. per minute.

The instrument illustrated above, consists of a pulley A, having arms specially shaped, and free to revolve around the shaft which absorbs the power to be measured. One half of the boss of this pulley is cut away, and does not project beyond the arms, in line with the shaft. Next to this pulley, on the shaft, and securely fastened to it, is a casting having arms B, similar in number to those of the loose pulley. Each arm carries a small cylinder C having a piston with a piston rod projecting through one end. The ends of these piston rods engage with the specially-shaped arms of the loose pulley. The cylinders are connected by pipes D to a chamber common to all, and located in line with the centre of the shaft on which the instrument is mounted. Beyond this chamber is a trunnion joint, permitting the connections

diminution varying with the nature of the non-electrolyte and with the degree of dilution. The four non-electrolytes, benzene, toluene, xylene and oil turpentine, diminish the conductivity in the order given. The diminution varies for each volume per cent. of non-electrolyte added from 1.7 to 2 per cent. of the conductivity of the corresponding normal solution for 0.01-normal solutions; 1.6-1.75 per cent. for 0.001-normal and 1.4-1.6 per cent. for 0.0005-normal. The temperature coefficients of alcoholic solutions increase with increasing dilution, are only half as great as in the case of aqueous solutions, and are very little affected by the addition of a non-conductor. The conductivity of methylic alcohol solutions up to a concentration of 20 per cent. of non-electrolyte is very exactly represented by Arrhenius's formula. No connection between electrical conductivity and fluid friction was evident.

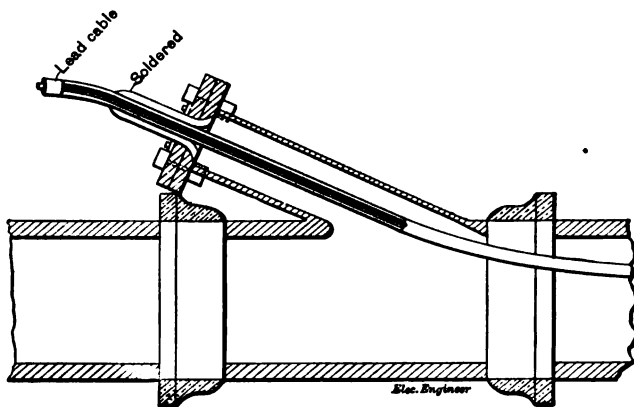
LAYING TELEPHONE CABLE IN WATER PIPES.

BY F. C. HUTCHINGS.

VANCOUVER, British Columbia, is blessed with a land locked harbor almost ideal in its perfection. This body of water is some three miles wide by sixteen long, is connected with the skirts of the Pacific by a neck of water twelve hundred feet wide at the narrowest place and sixty feet deep at the deepest, known as the Narrows. This channel through which all shipping of the Port must pass is quite beautiful and romantic, being surmounted on the one side by a perpendicular cliff 220 feet high; on the other side is a gravel flat, back of which tower lofty mountain peaks covered by perpetual snow.

Vancouver City is located on the south side of the Narrows, the water works dam fed by a mountain stream is on the north side. The water is conducted across the Narrows through submerged mains of flexibly jointed, heavy cast iron piping.

The tide of the Pacific does not rise and fall with the even regularity of the Atlantic tide but is very irregular and each run differs from the one preceding. On this upper coast the extreme from low to high tide is fourteen feet and the "runs" are about as follows: Starting at extreme



METHOD OF INSERTING TELEPHONE CABLE IN WATER PIPE.

high water mark it drops fourteen feet without stopping then turns and rises eight feet, drops back again four feet, turns once more and rises ten feet, reaching the starting point of extreme high water mark. When it turns again it goes down in two jumps and comes back in one long one. Thus there are four tides per day, two long and two short, and an immense volume of water must pour back and forth through the Narrows to adjust the level of this large harbor to that of the ever changing sea, causing in its transit a current which attains a maximum of over seven miles per hour during one period of the long run.

The water foams and roars through the Narrows with much noise and owing to its tremendous force renders the task of maintaining a pipe line extremely difficult, taxing the skill of City Engineer, Col. T. H. Tracy.

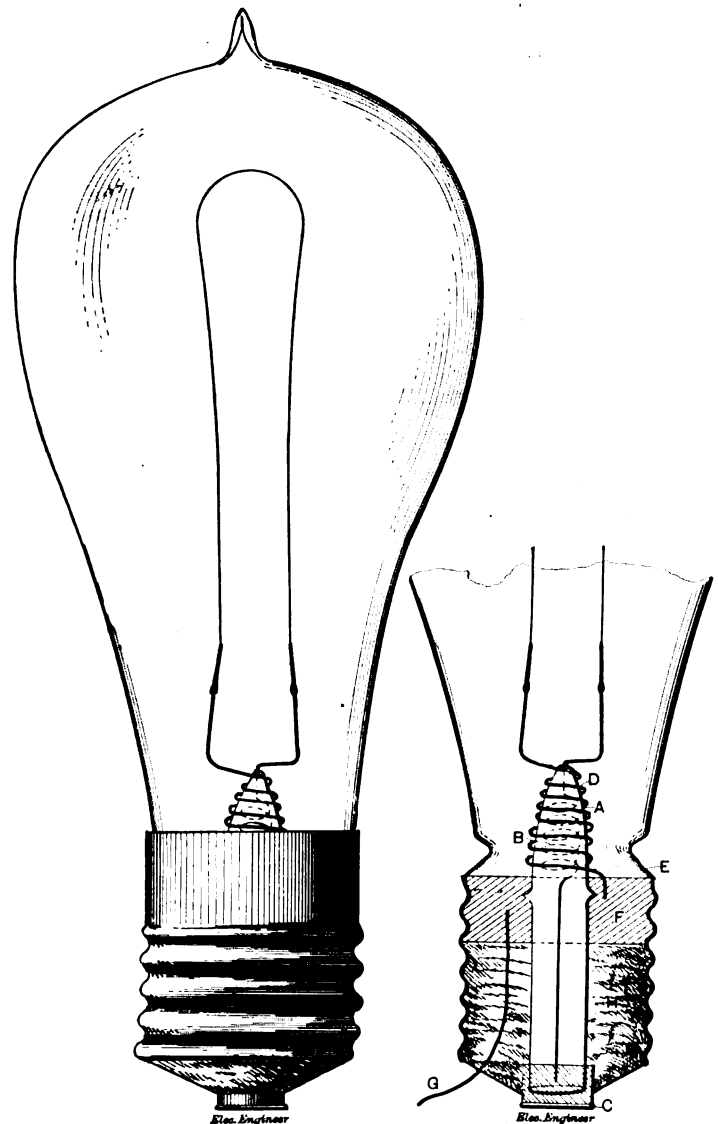
To establish communication between the water works dam and the city by telephone was attempted a number of times but every style of cable tried was soon destroyed by the force of the tide until Col. Tracy conceived the idea of laying the cable inside of the same pipe that supplied the city with water.

A lead covered cable with saturated fibrous covering was purchased of the Standard Underground Cable Co., of Pittsburgh, by the advice of C. T. Hutchings, superintendent of the local electric railway, the cable was pulled through the pipe and the lead covering soldered to a special lead fitting at either end, as shown in the accompanying drawing. This method has been thoroughly successful, no trouble having occurred since its installation; as all strain on the cable is from end to end with no lateral movement or vibration, there is no apparent reason why it should not remain unimpaired for an indefinite period.

THE LIVGRO INCANDESCENT LAMP.

The majority of recent attempts to produce an incandescent lamp free from the Edison claims have been directed toward obtaining a lamp which does not embody in its construction an all-glass receiver, and our readers will be interested in a lamp of this type invented by Dr. W. E. Forest, of New York, the manufacture of which is now being actively undertaken by the Livgro Incandescent Lamp Co., of Harrison, N. J.

The lamp is shown in perspective in the engraving Fig. 1, and Fig. 2 shows the method of construction adopted. As will be seen, the mount is a plain glass tube, A, 1 inch



FIGS. 1 AND 2.—THE LIVGRO INCANDESCENT LAMP.

in length, and $\frac{1}{4}$ inch in diameter, open at both ends. A coiled steel wire, B, 8 inches long, is placed within the tube as one of the current conductors. The bottom of the mount is set into a brass thimble, C, filled with a soft molten metal. On cooling, this metal seals the tube and fuses to the wire and thimble. The latter thus becomes the central terminal in the completed lamp.

Another coiled wire D is placed outside of the mount and passes through a pin hole in the mica disc E, projecting for a short distance beyond. The mount, with disc wires and filament attached, is then set in the neck of the lamp bulb, the whole is warmed to a proper temperature, the lamp inverted, and a soft molten metal F is poured into the bulb neck upon the disc, hermetically closing the neck.

This metal is cheap, melts at a very low temperature, and has a coefficient of expansion practically the same as that of glass. A copper conducting wire *g* hangs in the neck of the bulb to which the sealing metal fuses itself. This wire is attached to the screw cap for the other lamp terminal as usual.

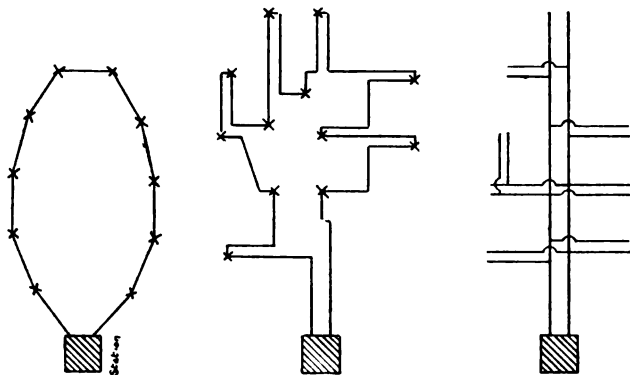
The screw-cap, without the porcelain separator and central button, is then slipped over the bulb neck, and a fusible, elastic cement *h* is poured in, that fills the remaining space in the neck of the bulb, and, at the same time, fastens the screw-cap on, thus rendering plaster unnecessary. The lamp is then ready for the exhausting pump. It will be seen that this lamp has no platinum wires, no glass fusing, no plaster, no leading-in-wires, properly speaking (both conducting wires terminate within the lamp). The incandescent filament is separated from the base by eight inches of steel wire, so that the heat cannot be transmitted to the seal; at the same time these wires are held by the mount so that they cannot vibrate and loosen the filament.

The inventor has devised a method of manufacturing these lamps by which hand labor will be but little used, and two or three girls can turn out several thousand per day.

STREET LIGHTING BY ALTERNATING ARCS.¹

BY CHARLES G. ARMSTRONG.

At first thought, the planning of a street lighting system for a city and using multiple instead of series wiring may seem expensive, but let us look at both sides. If we plat the ideal town



FIGS. 1, 2 AND 3.

plant we find the lamps all arranged along a circle or loop about as shown in Fig. 1, and no doubt the series arc system with a single wire is then the simplest and cheapest. But in practice we find that the towns are not often laid out to suit such simple wiring plans, while councilmen Smith and Jones and Brown all have their notions as to the location of the lamps; so the actual diagram is more like Fig. 2, much of the wiring being in loops so as to nearly double the length of the circuit. Of course every foot of this wire has to carry the full current (say ten amperes), whereas in a multiple system, like that shown in Fig. 3, the size of the wire would diminish as we get farther from the stations, both systems using about the same voltage (2,000). This difference in the cost of the wire may amount to considerable. In the case of a sixty light town plant for which I recently made the estimates, the alternating current transformer system showed a saving of ten per cent. on the wire over that which would have been needed for the same lamps on the ordinary series circuits.

As to the arc lamps themselves, there has been quite a change during the past year in the voltage adopted for them. The early forms were adapted to be run from 50-volt transformers with a resistance in series. Then this resistance was gradually reduced so as to run three lamps in series on a 100 volt circuit, thus giving better results and taking less energy. Lately the manufacturers have gone a step further by planning their lamps to work direct from 30-volt transformers, leaving out all resistance. The lamps themselves are as economical as the series lamps, each consuming about 450 watt for a nominal 2,000 candle power. Of course there is the extra cost of the transformer, but this, together with the alternating arc lamp itself, costs no more to-day than a first-class series lamp. The loss in the transformer

does not count for much, as the transformer is always worked at full load and therefore at its greatest efficiency. What is more, the transformer tends to steady the fluctuations in voltage at the lamp, so that this cannot creep up to 50 or 57 volts as it often does with series lamps.

One of the advantages gained by running arc lamps in multiple is that every lamp is independent of the rest. If a lamp should get out of order, it would keep its crankiness to itself without affecting all of the others. Indeed, the most that it could do would be to short circuit itself and blow the fuse of the transformer. The same advantage is found in case of a break on the line, as this only cuts out the lamps beyond the break instead of crippling the whole system. Likewise, only the joints between the given lamp and the dynamo interpose their effective resistance, while in series systems any and all bad joints affect the whole number of lamps. The voltage used at the lamps is harmless, they can be trimmed with safety at any time, and it is comparatively easy to plan the feeders for safety.

As to the illuminating power of the lamps, the direct current arcs have the advantage of throwing out most of the light-giving rays in a downward cone, whereas the alternating arc sends out a double cone of light. By using a reflector much of the upward projected light can be thrown downward, and in the case of street lighting a portion of the rays will be reflected from the under surface of the foliage. So I think, that for the low suspension commonly used throughout the country, the alternating arc is the proper one, while for tower lighting the direct current arc would be preferable.

In comparing the energy of the two systems, the commercial efficiency of the dynamos and the cost of armature repairs will also be an important item. Good series generators show an efficiency of from 80% to 85% when built, but after a few years this falls to 70% and often as low as 50%. On the other hand we can count on from 85% to 90% or even 92% when using alternators, and can figure on quite a saving for armature repairs. I have seen figures from three hundred arc light stations which average \$3.00 per year per arc lamp for armature repairs alone. This agrees with the commonly known fact that arc armatures are much more likely to be damaged than those of an alternator. I believe that under similar conditions an alternating armature will outlast from two to three arc armatures.

The matter of carbons for alternating arcs has been an important question, as a fine grade is needed for this work. The lamp manufacturers have wisely taken the expedient of using an enclosing globe, so as to make a carbon last 18 hours which otherwise would be consumed in 14 hours. Moreover the carbon manufacturers in this country are hastening to bring out a grade of carbons suited for alternating current work, and the probability is that we can soon purchase American carbons for these lamps at prices not much in advance of that charged for the hard series arc carbons.

I have already spoken of the greater efficiency which we can readily expect from the alternating generators. We can also get them in larger sizes, so that in place of from 12 to 20 series machines, each with a capacity of eighty to one hundred lights, we would have, say, three generators of 300 to 400 horse power each, these being preferably slow speed machines, connected direct to the engines, thus doing away with belts, ropes and shafting.

At present the common voltage for the primary circuits is about 2,000, having grown to this point from 500 from which it started, and I believe we can assume from 2,000 to 2,500 volts as our settled standard. Still, if I were to plan an ideal arc lighting plant for a large city, I would choose a still higher voltage, perhaps 4,000 volts. My station would be some three or four miles out of town and I would run my wires in conduits to some distributing centres in the city, transforming at these points to 2,000 volts and running thence to the alternating arcs.

Figure out such a plant for a good sized town, and note the saving in circuits alone as compared with series circuits which have only from 50 to 100 lights each. You will then see what the prospects are for the extensive use of alternating currents in connection with street lighting by arc lamps.

THE BANGOR, ME., MUNICIPAL PLANT.

At a recent meeting of the Bangor city government, a proposition of Mr. Clergue that the city should transfer to a syndicate the electric lighting of the city and the control of the water power, was withdrawn by him in deference to the general expression of public disapproval. He gave notice, however, that he should submit to the water board another proposition embracing the lease or transfer of the control of the water power to the syndicate represented by him.

A TELEPHONIC TEST OF ABILITY.

It is stated that a London merchant requires all applicants for clerkship to hold conversations over the telephone, and forms his opinion of their ability from their answers. His theory is that the day is rapidly approaching when three-fourths of the business will be transacted by telephone, and that a clerk who is careless or indifferent in replying to inquiries will drive customers away.

1. Abstract of a paper read before the Chicago Electrical Association.

THE WORK OF HERTZ.¹—I.

BY DR. OLIVER J. LODGE, F.R.S.



Heinrich Hertz.

did he not go till he had effected an achievement which will hand his name down to posterity as the founder of an epoch in experimental physics.

In mathematical and speculative physics others had sown the seed. It was sown by Faraday, it was sown by Thomson and by Stokes, by Weber also doubtless, and by Helmholtz, but in this particular department it was sown by none more fruitfully and plentifully than by Clerk Maxwell. Of the seed thus sown Hertz reaped the fruits. Through his experimental discovery, Germany awoke to the truth of Clerk Maxwell's theory of light, of light and electricity combined, and the able army of workers in that country (not forgetting some in Switzerland, France and Ireland) have done most of the gleanings after Hertz.

This is the work of Hertz which is best known; the work which brought him immediate fame. It is not always that public notice is so well justified. The popular instinct is generous and trustful, and it is apt to be misled.

The scientific eminence accorded to a few energetic persons by the popular estimate is more or less amusing to those working in the same lines. In the case of Hertz no such mistake has been made. His name is not over well known, and his work is immensely greater in every way than that of several who have made more noise. His best known discovery is by no means his only one. I have here a list of eighteen Papers contributed to German periodicals by him, in addition to the Papers incorporated in his now well-known book on electric waves. I would like to suggest that it would be an act of tribute, useful to students in this country, if the Physical Society of London saw their way to translate and publish a collection of, at any rate, some of these Papers.²

Portrait Slide.

The portrait which I show is not a specially pleasing one. It is from a photograph taken by Mr. Yule, one of the band

1. A lecture delivered at the Royal Institution, June 1. Dr. Lodge was ably assisted during both preparation and performance by Mr. Edward E. Robinson.
2. *Hertz's Papers*.
- 1878-79. *Wied. Ann.*, 1880, vol. 10, p. 414. Experiments to establish an Upper Limit for the Kinetic Energy of Electric Flow.
1880. Inaugural Dissertation (Doctor Thesis) on Induction in Rotating Spheres.
1881. Vol. 13, *Wied. Ann.*, p. 266. On the Distribution of Electricity on the Surface of Moving Conductors.
1881. (?) *Orelle*, vol. 92, p. 156. On the Contact of Solid Elastic Bodies.
1881. Vol. 14, *Wied. Ann.*, p. 581. Upper Limits for the Kinetic Energy of Moving Electricity.
1882. *Verhandlungen des Vereins des Gewerbetreibenden* (Sonderabdruck). On the Contact of Solid Elastic Bodies and on Hardness.
1882. *Wied. Ann.*, vol. 17, p. 177. On the Evaporation of Liquids, especially of Quicksilver, in Air-Free Space, and on the Pressure of Mercury Vapor.
1882. *Verhandl. d. phys. Gesellschaft in Berlin*, p. 18. On a New Hygrometer.
1883. March. *Schönmacher Zeitschrift*, p. 125. On the Distribution of Pressures in an Elastic Circular Cylinder.
1883. *Wied. Ann.*, vol. 19, p. 78. On an Appearance Accompanying Electric Discharge.
1883. *ib.*, vol. 19, p. 782. Experiments on Glow Discharge.
1883. *Wied. Ann.*, vol. 20, p. 279. On the Property of Benzine as an Insulator and as showing Elastic Reaction (Rückstandsabdrücke).
1883. *Zeitschrift für Instrumentenkunde*. Dynamometric Contrivance of Small Resistance and Infinitesimal Self-Induction.
1884. *Met. Zeitschrift*, November, December. Graphic Methods for the Determination of the Adiabatic Changes of Condition of Moist Air.
1884. *Wied. Ann.*, vol. 22, p. 449. On the Equilibrium of Floating Elastic Plates.
1884. *ib.*, vol. 23. On the Connection between Maxwell's Electro-dynamic Fundamental Equations and those of Opposition Electrodynamics.
1885. *ib.*, vol. 24, p. 114. On the Dimension of a Magnetic Pole in different Systems of Units.
- 1887-1889. Papers incorporated in his book, "Ausbreitung der Elektrischen Kraft," translated under the title of "Electric Waves."
1892. *Wied. Ann.*, vol. 46, p. 28. On the Passage of Cathode Rays through Thin Metal Sheets.

of foreign students who flocked to Hertz's laboratory at Bonn. It is excellent as a photograph, though it fails to represent Hertz at his best; perhaps because it was not taken till after the pharyngeal trouble had set in, which ultimately carried him off.

In closing these introductory and personal remarks, I should like to say that the enthusiastic admiration for Hertz's spirit and character, felt and expressed by students and workers who came into contact with him, is not easily to be exaggerated. Never was a man more painfully anxious to avoid wounding the susceptibilities of others; and he was accustomed to deprecate the prominence given to him by speakers and writers in this country, lest it might seem to exalt him unduly above other and older workers among his own sensitive countrymen.

Speaking of the other great workers in physics, in Germany, it is not out of place to record the sorrow with which we have heard of the recent death of Dr. August Kundt, Professor in the University of Berlin, successor to von Helmholtz in that capacity.

When I consented to discourse on the work of Hertz, my intention was to repeat some of his actual experiments, and especially to demonstrate his less known discoveries and observations. But the fascination exerted upon me by electric oscillation experiments, when I, too, was independently working at them in the spring of 1888,³ resumed its hold, and my lecture will accordingly consist of experimental demonstrations of the outcome of Hertz's work rather than any precise repetition of portions of that work itself.

In case a minority of my audience are in the predicament of not knowing anything about the subject, a five minutes' explanatory prelude may be permitted, though time at present is very far from being "infinitely long."

The simplest way will be for me hastily to summarize our knowledge of the subject before the era of Hertz.

Just as a pebble thrown into a pond excites surface ripples, which can heave up and down floating straws under which they pass, so a struck bell or tuning-fork emits energy into the air in the form of what are called sound waves, and this radiant energy is able to set up vibrations in other suitable elastic bodies.

If the body receiving them has its natural or free vibrations violently damped, so that when left to itself it speedily returns to rest (Fig. 2), then it can respond fully to notes of almost any pitch. This is the case with your ears and the tones of my voice. Tones must be exceedingly shrill before they cease to excite the ear at all.

If, on the other hand, the receiving body has a persistent period of vibration, continuing in motion long after it is left to itself (Fig. 3) like another tuning-fork or bell, for instance, then far more facility of response exists, but great accuracy of tuning is necessary if it is to be fully called out; for if the receiver is not thus accurately syntonized with the source, it fails more or less completely to resound.

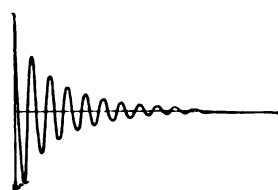


FIG. 2.

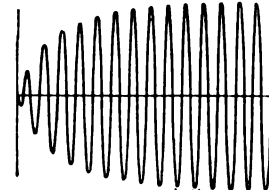


FIG. 3.

Conversely, if the source is a persistent vibrator, correct tuning is essential, or it will destroy at one moment (Fig. 4) motion which it originated the previous moment. Whereas, if it is a dead-beat or strongly-damped exciter, almost anything will respond equally well or equally ill to it.

What I have said of sounding bodies is true of all vibrators in a medium competent to transmit waves. Now a sending telephone or a microphone, when spoken to, emits waves into the ether, and this radiant energy is likewise able to set up vibration in suitable bodies. But we have no delicate means of directly detecting these electrical or ethereal waves, and if they are to produce a perceptible effect at a distance, they must be confined, as by a speaking tube, prevented from spreading, and concentrated on the distant receiver.

This is the function of the telegraph wire; it is to the ether what a speaking tube is to air. A metal wire in air (*in function*, not in details of analogy) is like a long hollow cavity surrounded by nearly rigid but slightly elastic walls.

Sphere Charge from Electrophorous.

Furthermore, any conductor electrically charged or discharged with sufficient suddenness must emit electrical waves into the ether, because the charge given to it will not settle down instantly, but will surge to and fro several times first, and these surgings or electric oscillations must, according to Maxwell, start waves in the ether, because at the end of each half swing they cause electro-

3. *Phil. Mag.*, XXVI, pp. 229, 230, August, 1888; or "Lightning Conductors and Lightning Guards" (Whittaker), pp. 104, 105; also *Proc. Roy. Soc.* Vol. L. p. 27.

static, and at the middle of each half swing they cause electromagnetic effects, and the rapid alternation from one of these modes of energy to the other constitutes etherial waves.⁴ If a wire is handy they will run along it, and may be felt a long way off. If no wire exists they will spread out like sound from a bell, or light from a spark, and their intensity will decrease according to the inverse square of the distance.

Maxwell and his followers well knew that there would be such waves; they knew the rate at which they would go, they knew that they would go slower in glass and water than in air, they knew that they would curl round sharp edges, that they would be partly absorbed but mainly reflected by conductors, that if turned back upon themselves they would produce the phenomena of sta-

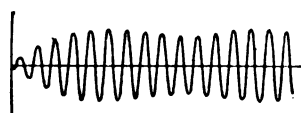


FIG. 4.



FIG. 6.

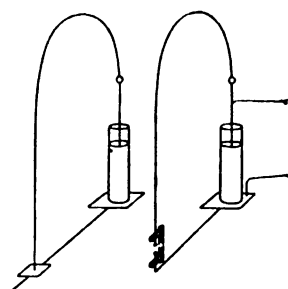


FIG. 5.

tionary waves, or interference, or nodes and loops; it was known how to calculate the length of such waves, and even how to produce them of any required or pre-determined wave length from 1,000 miles to a foot. Other things were known about them which would take too long to enumerate: any homogeneous insulator would transmit them, would refract or concentrate them if it were of suitable shape, would reflect none of a particular mode of vibration at a certain angle, and so on, and so on.

All this was known, I say, known with varying degrees of confidence, but by some known with as great confidence as, perhaps even more confidence than, is legitimate before the actuality of experimental verification.

Hertz supplied the verification. He inserted suitable conductors in the path of such waves, conductors adapted for the occurrence in them of induced electric oscillations, and to the surprise of everyone, himself doubtless included, he found that the secondary electric surges thus excited were strong enough to display themselves by minute electric sparks.

Syntonic Leyden Jars.

I shall show this in a form which requires great precision of tuning or syntony, both emitter and receiver being persistently vibrating things giving some 30 or 40 swings before damping has a serious effect. I take two Leyden jars with circuits about a yard in diameter, and situated about two yards apart (Fig. 5). I charge and discharge one jar, and observe that the surges set up in the other can cause it to overflow if it is syntonized with the first.⁵

A closed circuit such as this is a feeble radiator and a feeble absorber, so it is not adapted for action at a distance. In fact, I doubt whether it will visibly act at a range beyond the $\frac{1}{2}\lambda$ at which true radiation of broken off energy occurs. If the coatings of the jar are separated to a greater distance, so that the dielectric is more exposed, it radiates better; because in true radiation the electrostatic and the magnetic energies are equal, whereas in a ring circuit the magnetic energy greatly predominates. By separating the coats of the jar as far as possible we get a typical Hertz oscillator (Fig. 6), whose dielectric extends out into the room, and this radiates very powerfully.

Ordinary Size Hertz Vibrator.

In consequence of its radiation of energy, its vibrations are rapidly damped, and it only gives some three or four good strong swings. Hence it follows that it has a wide range of excitation, i. e., it can excite sparks in conductors barely at all in tune with it.

The two conditions, conspicuous energy of radiation and persistent vibration electrically produced, are at present incompatible. Whenever these two conditions coexist, considerable power or activity will, of course, be necessary in the source of energy. At present they only coexist in the sun and other stars, in the electric arc and in furnaces.

4. Strictly speaking, in the waves themselves there is no lag or difference of phase between the electric and the magnetic vibrations; the difference exists in emitter or absorber, but not in the transmitting medium. True radiation of energy does not begin till about a quarter wave-length from the source, and within that distance the initial quarter period difference of phase is obliterated. 5. See *Nature*, Vol. XLII., p. 368; or J. J. Thomson, "Recent Researches," p. 365.

Two Circular Vibrators sparking in sympathy.

The receiver Hertz used was chiefly a circular resonator, not a good absorber but a persistent vibrator, well adapted for picking up disturbances of precise and measurable wave-length. I find that the circular resonators can act as senders too; here is one exciting quite long sparks in a second one.

Electric Syntony.—That was his discovery, but he did not stop there. He at once proceeded to apply his discovery to the verification of what had already been predicted about the waves, and by laborious and difficult interference experiments he ascertained that the previously calculated length of the waves was thoroughly borne out by fact. These interference experiments in free space are his greatest achievement.

He worked out every detail of the theory splendidly, separately analyzing the electric and the magnetic oscillation, using language not always such as we should use now, but himself growing in theoretic insight through the medium of what would have been to most physicists a confusing maze of troublesome facts, and disentangling all their main relations most harmoniously.

Holtz Machine, A and B Sparks; Glass and Quartz Panes in Screen.

While Hertz was observing sparks such as these, the primary or exciting spark and the secondary or excited one, he observed as a bye issue that the secondary spark occurred more easily if the light from the primary fell upon its knobs. He examined this new influence of light in many ways, and showed that although spark light and electric brush light were peculiarly effective any source of light that gave very ultra-violet rays produced the same result.

Wiedemann and Ebert, and a number of experimenters, have repeated and extended this discovery, proving that it is the cathode knob on which illumination takes effect; and Hallwachs made the important observation, which Righi, Stoletow, Branly, and others have extended, that a freshly-polished zinc or other oxidizable surface, if charged negatively, is gradually discharged by ultra-violet light.

It is easy to fail in reproducing this experimental result if the right conditions are not satisfied; but if they are, it is absurdly easy, and the thing might have been observed nearly a century ago.

AN ASTATIC STATION VOLTMETER.¹

BY W. E. AYETON, F.R.S., PAST-PRESIDENT, AND T. MATHER, ASSOCIATE.

THE rapid development of electric lighting generating stations during the past three years has resulted in a greatly increased perfection in the regulation of the pressure, and consequently has created a need for measuring instruments of much greater precision than was previously required. At the same time, the powerful dynamos now employed, and the large currents, that flow through the mains on the switchboards at these generating stations, has greatly increased the disturbing influences to which electromagnetic measuring instruments are subjected. Consequently, it is not to be wondered at that voltmeters and ammeters which answered fairly when the output of the stations was small have had to be discarded as being unsuitable for the present requirements.

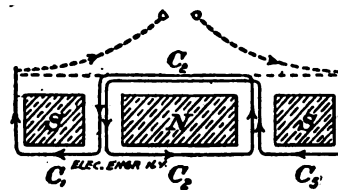


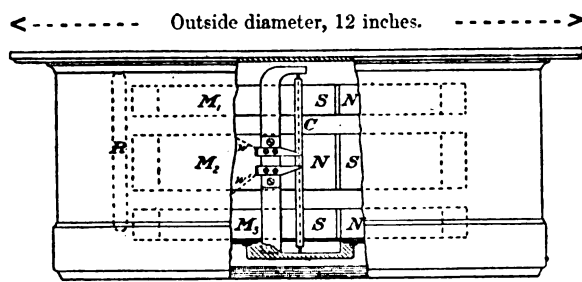
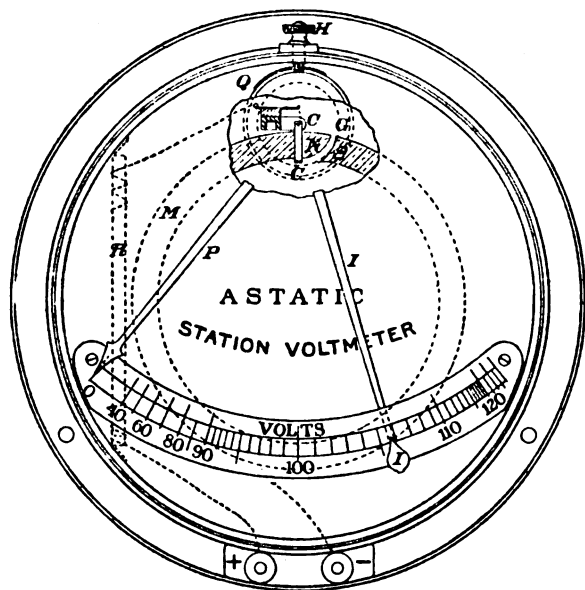
FIG. 1.—ASTATIC STATION VOLTMETER.

The authors have been engaged for some time past in developing an electromagnetic voltmeter to fulfill the following conditions: 1. Be unaffected by an outside magnetic field, whether uniform or not, and as strong as the disturbing magnetic field on any ordinary central station switchboard. 2. Be unaffected by an outside electrostatic disturbance such as is produced on rubbing the glass front of the instrument. 3. Have no temperature error. 4. Have a high resistance, so as to measure equally accurately the true pressure at the end of long thin pilot wires, or in the station itself. 5. Have a scale of large radius, and one very open at the working pressure, so that a small change in the pressure can be detected. 6. Be dead beat.

Condition No. 1 is most easily fulfilled by employing a powerful stationary permanent magnet and a moving coil, for such an

1. Abstract of a paper read before the London Institution of Electrical Engineers, April 12, 1894.

arrangement has the great advantage that it cannot indicate a pressure unless a current be actually flowing through the coil; whereas soft iron and other types of voltmeters, when placed in a fairly strong magnetic field, may have the pointer deflected across the scale when no current whatever is passing through the instrument. But it is not sufficient to merely employ one permanent magnet and one moving coil. If the coil be wound astatically, and be acted on by two powerful permanent magnets inside the voltmeter, with their poles oppositely directed, good screening can be obtained from a uniform disturbing magnetic field; but errors will be produced if the disturbing field be non-uniform, such as is caused by a mass of iron, or by a conductor carrying a current, placed near the voltmeter. We have, therefore, carried this principle of astaticism further by employing three permanent magnets and a coil wound in three parts as shown diagrammatically in Fig. 1, the area of the middle coil being double that of either of the end ones; and in this way we have obtained an arrangement which is comparatively unaffected by either a uniform or a non-uniform magnetic disturbance.



FIGS. 2 AND 3.—ASTATIC STATION VOLTMETER.

The moving coil principle also enables conditions 3 and 4 to be fulfilled, for the resistance of this 100-volt instrument is about 7,000 ohms; and as only 3 per cent. of this is composed of copper wire—viz., that wound on the moving triple coil—while 97 per cent. is of manganin wire, indicated by the stationary coil *R* in Figs. 2 and 3, the temperature error is practically negligible. This high resistance also causes the power required to actuate the voltmeter to be very small, not more than about $1\frac{1}{2}$ watts being absorbed at 100 volts with this voltmeter.

The control is produced by a weight, because this is the method of exercising a controlling force that is least likely to vary, and because the objection to the employment of a gravity control—that the voltmeter cannot be used in any position—is of no importance in the case of a switchboard instrument.

Fig. 2 shows the voltmeter in elevation, while Fig. 3 gives a plan; both figures being drawn partly in section, so that the working parts may be more clearly seen. The triple coil C_1, C_2, C_3 , (Fig. 1) passes over the poles of the three magnets, M_1, M_2, M_3 , (Fig. 3), the direction of the winding being such as to cause the deflecting forces for each portion of the coil to be in the same direction. The current is led up to and away from the coil by very thin flexible silver strips attached to the points of the stationary pieces *w, w'* (Fig. 3).

Conditions 5 and 6 are satisfied by specially shaping the air gaps, and we find that without sacrificing the quickness of motion of the pointer *P* too much, we can flatten the calibration curve at the working part of the scale so that $\frac{1}{100}$ part of a volt variation in the pressure can be detected. The inside of the glass cover is coated with a layer of our transparent conducting varnish¹ and the instrument is thus screened from outside electrostatic action. Hence there is no fear of a change in the reading being produced by cleaning the glass—a very serious source of error, which is not uncommon with electromagnetic voltmeters in actual use in electric light central stations.

CIRCULAR GRAVITY.

THE ELECTRICAL ENGINEER always strives to give its readers the benefit of the scientific researches of genius. The more retiring the genius the greater is the pleasure it takes in assisting it to bud; perchance, to burst into bloom. It is therefore with great joy that we present *verb et lit*, the following letter kindly sent us by a well-known firm of engineers. The letter was received by the president of one of the electric street railway companies, whose line they are building and will prove interesting and instructive to those who desire higher education in mechanics and electricity:

Unlontown May 7th 1894

Messrs of Philadelphia

the Electric St car Co Sirs I learn that you intend depending of horse power on the St car lines in City in Stead thereof use Electric power I now inform you to send a mechanical expert to Unlontown Jno C Fulton's office Main St opposite the Lafayette Hotel

I can instruct him how to transverse Gravity to Gravitate perfectly level round and round in Stead of down down giving more power than to gravitate down down therefore you will at once pecieve you can propel your St Cars with perfect Safety Speed and Cheap not using any of the elements Gravity is not an element

what you intend doing do quickly

N B you will read but one rail that in the centre the rail the Shape of alphabeti- cal letter A the centre wheel to have a groove on the periphery of the same to straddle the letter A all other wheels Broad tread the face of the Locomotive driving wheels we will make a bout one foot Broad So that havy grades will be ascended easily

John M Weltner
81 mill St Union Town P A

We understand that Mr. Weltner is about to be appointed Electrician Extraordinary to Coxey's Army, where he will continue to gravitate round and round instead of down down. He has equipped himself with his own system and the wheels in his head (which have grooves in their peripheries) will enable him to straddle.

LONG-DISTANCE LIGHTING AT UNION, MO.

THE electric lights in the Town of Union, Mo., were successfully started on the evening of June 6th, the event being made the occasion of a great celebration. This plant, which was designed by Wm. H. Bryan, Consulting Engineer, of St. Louis, presents some novel features. The lights are operated from Mr. A. A. Tibbe's Westinghouse station at Washington, Mo., ten miles distant. The current used on the primaries in Washington and Union is 1,000 volts alternating. At Washington a step-up transformer is used, raising the voltage to 4,000, and the current is then transmitted over a pair of No. 8 wires, a step-down transformer being located at the entrance to the Town of Union. The service in Union consists at present of 250 16 c. p. commercial lights, and 5-50 and 16-32 c. p. street lamps. Although Union is a town of less than 1,000 inhabitants and the consumption of light there is necessarily limited, the recent advancements in transformer construction and the low cost of copper have made it possible to handle this service profitably from the Washington plant. It is estimated that with the average load the losses due to transformation and transmission will not exceed 5 %.

ELECTRIC FANS AS WHEELS OF FORTUNE.

WALL street needs something to kill the long and weary wait into which business in many offices has resolved itself, and the something, says the *New York World*, has been found in the electric fan with which every office is provided. This fan has been turned into a wheel-of-fortune. Take any fan and the number of flukes, either by scratching figures upon them or by pasting paper numbers on the brass arms. One arm should have a 0 upon it. This wins the kitty for the house. Then as many players as there are remaining arms make a pool, each contributing his dollar or his dime, according to the financial standing of the crowd, and each selecting a number. Any number of players may participate in the same turn. The fan is set running and a touch of the switch-button brings it to a standstill. The number on the fluke on top nearest the vertical wire of the cage which protects the fan wins the pot. Then is heard the alluring cry of the game-keeper: "Now, gentlemen, who are in the next pool? Ante up and take your numbers. Thank you. All full. Stop her again. No. 4 wins. Here you are. Now, then, once more," and so on until some special quotation on the ticker calls the group away to watch the returns from the different and bigger game going on in the Exchange over the way.

2. See THE ELECTRICAL ENGINEER, May 2, 1894.

ELECTRIC TRANSPORTATION DEPARTMENT.

TROLLEY CROSS-COUNTRY ROADS IN CONNECTICUT.

A glance at the roads now in course of construction in this State, says the *Hartford Times*, will show the possibilities of electricity in the future. Within a month people will be able to ride from Winchester's factory to Woodmont, a distance of about ten miles, most of it along the Sound. The plan is to extend this journey from Woodmont to Milford, thence to Stratford and connect with the Bridgeport electric road to Bridgeport. Bridgeport has a half-million job in the works and will pierce into Fairfield and possibly to Westport. The two Norwalks are now stricken with the electric fever and the Norwalk Tramway Company plays between Norwalk and South Norwalk, while the east side line is completing another circle. Ro-on Point, three miles away on the Sound, is to be reached, and little hamlets are promised branches. Stamford will extend her lines to Canaan and work is progressing to Shippan point. Greenwich is promised a branch line this summer, and plans are executed for a big line extending to the Norwalks.

Meriden has a new line in operation to Wallingford, a distance of eight miles. Wallingford is in easy reach of New Haven with the town of North Haven between. Middletown has laid lines to the insane asylum one side and to South Farms, and when the new bridge is reached will run a line into Portland. The Middletown company has, also, a layout to Meriden. Hartford has lines operating to Glastonbury and Wethersfield, with assurances of greater extensions. New London and Norwich are being electrically equipped and Danbury will soon have lines operating to Bethel and Lake Kenosha. Up the Naugatuck valley Waterbury will have the busy town of Naugatuck connected with the electric road by August. Lines are also laid out for connecting Watertown and Waterville with the Brass City. Derby is circling the associate villages with an electrical band and Seymour, four miles away, will be reached in a short period, it is said. Naugatuck is about eight miles from Seymour with the town of Beacon Falls between. An electric road from Derby at tide water to the Brass City, sixteen miles away, is one of the many assurances of the electrical future.

FRANKLIN INSTITUTE DISCUSSES PIPE ELECTROLYSIS.

At the last meeting of the Franklin Institute there was a general discussion on the subject of the injury to underground metal pipes, caused by the leakage from the return current of the trolley lines. A paper on the subject by J. H. Vail, the electrical engineer and expert, of New York, was read by Dr. Wahl, Secretary of the Institute. Mr. Vail said that frequent tests have proved that the conductivity of the earth is overestimated, and if no superior path is offered the current will take iron and lead pipes. The electric current must, under natural laws, follow the path of least resistance. He believed that the existing methods of utilizing railway tracks for conducting large quantities of current are faulty in at least three particulars:

First. Restricted conductivity at joints, due to insufficiency of the rail bonds.

Second. Neglecting to properly utilize the track as a conducting medium.

Third. Failure to provide a complete metallic return of low resistance.

For electrical purposes the rail plates and bolts are not of any permanent value. The rail sections are in many systems of ample conductivity to carry more than the requisite current, provided they are perfectly bonded and properly connected with the dynamos.

Mr. Vail did not consider supplementary wire of much value, and thought that more attention should be given to perfect bonding of the rail joints and to apply track feeders in such a manner as to fully utilize the conductivity of the track. He expressed a decided preference for adequate underground feeders for the track system as being permanent and subject to the least cost for repairs.

Dr. Wahl also read a few notes from Professor Edwin J. Houston and A. E. Kennelly, who were unable to be present. They took the ground that the current should either be prevented from entering the iron pipes, or, having entered them, prevented from leaving. Under the first plan the ground system of the trolley should be low of resistance and the pipe system so high of resistance that the amount of current which will be diverted from the trolley returns to the pipes will be small. The execution of the second plan requires that the conductance of the pipe system shall be great and connected with the trolley system. The problem is a perfectly definite one, its limitations are within engineer-

ing capabilities, and there is no reason to fear that the bright future of the electric railroads will be marred by the barriers of municipal water pipe system.

A. Langstaff Johnston, Chief Engineer of the Hestonville, Mantua and Fairmount Passenger Railway Company, spoke of the need of perfect contact in bonding rail joints to secure the best results.

SOME TROLLEY DATA FROM PHILADELPHIA.

ONE month of the Tenth and Eleventh streets trolley has, according to Vice-President Gandy, of the Electric Traction Company, shown its great value. There were formerly used on the road 450 horses, and these in a month would consume two and a half tons of hay, two tons of cut hay, about 8,000 pounds of feed and two tons of straw. All of this cost the road in a month, together with shoeing, about \$4,500. As an offset to this the amount of coal consumed last month cost only \$585, a clear saving by the trolley of \$3,915. To look after these 450 horses required the services, on an average, of 18 men around the stables and in the car sheds. Nearly all of these are now dispensed with and \$5,000 about represents how much the Electric Traction Company has saved in expenses. Further than this the travel has increased about 25 per cent.

ENGINES FOR THE HARTFORD, CONN., STREET RAILWAY.

The Ball & Wood Company has again been successful in securing through its secretary and treasurer, Mr. Vincent, one of the largest power contracts which has recently been placed. The order comprises six Ball & Wood improved cross compound condensing engines of 300 h. p. each, for the Hartford, Conn., Street Railway Company. This type and make of engine proved very economical and efficient at the Grand Street Station of the Consolidated Traction Company in Jersey City where the duty has been most severe and the engines subjected to almost constant overloads of from twenty to fifty per cent., pending the increase of the power plant. The factory of the Ball & Wood Company has been running twenty-four hours per day since about June 1st, and this Hartford contract will permit no diminution of its force for some weeks. In times like these, such activity is unusual, and it reflects the popularity of these engines.

ELECTRIC TRACTION IN OTTAWA, CAN.

The Electric Street Railway System of Ottawa, Can., put in by Ahearn & Soper, carried 2,700,000 passengers during the year just ended. The authorized capital of the consolidated interests is \$1,000,000. The company has 65 cars in all and since 1891 has laid 22 miles of single track. It has a generating plant of 1,700 h. p. capacity.

RAILWAY ELECTROLYSIS AT ST. JOSEPH, MO.

Complaint is made of serious electrolysis of water and gas pipes in the streets of St. Louis, Mo., due to the escape of current from the electric railway tracks. Gas pipes down only two weeks have big holes in them and workmen excavating receive shocks. The tracks evidently need overhauling.

ELECTRIC ELEVATED FOR CHICAGO.

It is stated that the General Electric Co. has been awarded a contract for the equipment of the Metropolitan Elevated Road of Chicago, which is to be operated by electricity on the plan of the World's Fair Intramural.

THE INDEPENDENT ELECTRIC TRACTION Co., Chicago, are exhibiting their new street car motor, an invention of Mr. W. H. Patton. Mr. Patton employs a gas engine to drive a generator, which in turn charges a set of accumulators for supplying current to the street car motor proper. The engine, dynamo and storage batteries are placed in the centre of the car in a compartment by themselves, the tank for the gasoline or compressed gas being located on the roof of the car. While a combination of this kind, with the losses attending the several transformations of energy, must necessarily be more or less uneconomical, the inventor claims that he can operate cars under his system at one-half the expense of maintaining an overhead trolley system.

THE ELECTRICAL ENGINEER.

(INCORPORATED)

PUBLISHED EVERY WEDNESDAY AT

203 Broadway, New York.

Telephone: 3860 Cortlandt.

Cable Address: LENGINEER.

Geo. M. Phelps, President.

F. R. COLVIN, Treas. and Business Manager.

Edited by

T. COMMERFORD MARTIN AND JOSEPH WETZLER.

Associate Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue, Boston, Mass.

Western Editor and Manager C. KAMMEYER, 1429 Monadnock Building, Chicago, Ill.

New York Representative, 203 Broadway, } W. F. HANES.
Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada, - - - - -	per annum, \$3.00
Four or more Copies, in Clubs (each) - - - - -	2.50
Great Britain and other Foreign Countries within the Postal Union " - - - - -	5.00
Single Copies, - - - - -	.10

[Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1888.]

VOL. XVIII.

NEW YORK, JULY 4, 1894.

No. 322.

CONTENTS.

EDITORIAL :—	PAGE.
Power Transmission at the Paris Exposition of 1900.....	10
Electrolytic Copper.....	11
ARTICLES :—	
Curious Effects of Hertzian Waves.....ELIHU THOMSON.	1
The Waterhouse Electrolytic Meter (<i>Illustr.</i>).....	1
A Simple Explanation of the Possible Cause of Self-Induction (<i>Illustr.</i>).....	2
A New Type of Dynamometer (<i>Illustr.</i>).....J. A. CROSS.	2
Laying Telephone Cable in Water Pipes (<i>Illustr.</i>).....F. C. HUTCHINGS.	4
The Livgro Incandescent Lamp (<i>Illustr.</i>).....	4
Street Lighting by Alternating Arcs (<i>Illustr.</i>).....C. G. ARMSTRONG.	5
The Work of Hertz.—I. (<i>Illustr.</i>).....DR. OLIVER J. LODGE.	6
An Astatic Station Voltmeter (<i>Illustr.</i>).....W. E. AYRTON & T. MATHER.	7
Electricity as a Fire Hazard.—I. (<i>Illustr.</i>).....W. J. JENES.	12
Reactance (<i>Illustr.</i>).....O. P. STERNMETZ & F. BEDELL.	13
The Experimental Search Light at Sandy Hook.....	14
ELECTRIC TRANSPORTATION DEPARTMENT :—	
Trolley Cross Country Roads in Connecticut.—Franklin Institute Discusses Pipe Electrolysis.—Some Trolley Data in Philadelphia.—Engines for the Hartford, Conn., Street Railway.—Electric Traction in Ottawa, Can.—Railway Electrolysis at St. Joseph, Mo.—Electric Elevated for Chicago.—Independent Electric Traction Co.....	9
NEWS AND NOTES :—	
Municipal Lighting Plant for Hamilton, Ohio.....	2
Change of Conductivity of a Solution by the Addition of a Non-Electrolyte.....	3
The Bangor, Me., Municipal Plant.....	5
A Telephonic Test of Ability.....	5
Circular Gravity.....	8
Long Distance Lighting at Union, Mo.....	8
Electric Fans as Wheels of Fortune.....	8
LITERATURE :—	
Bigelow's "An International System of Electro-Therapeutics.".....H. NEWMAN LAWRENCE.....	14
LETTERS TO EDITOR :—	
The Calorimeter in Boiler Tests.....E. H. PRABODY.	15
Bus Bar or Self Excitation for Railway Dynamos.....C. S. VAN NUIS.	15
SOCIETY AND CLUB NOTES :—	
Northwestern Electrical Association.....	15
Richmond Electric Club.....	15
COLLEGE NOTES :—	
West Virginia University.....	15
Yale University.....	15
LEGAL NOTES :—	
An Important Subway Decision in New York.....	16
Injunction in Detroit as to Electric Light Towers.....	16
Railway Rights of the Postal Co.....	16
Bell Telephone Stock Legislation.....	16
PERSONAL :—	
Gen. B. F. Peach.....	16
An Accident to Mr. Edison.....	16
INVENTORS' RECORD :—	
Classified Digest of U. S. Electrical Patents Issued June 19, 1894.....	16
REPORTS OF COMPANIES :—	
Financial Plans of the United Electric Light & Power Co.....	17
TRADE NOTES AND NOVELTIES AND MECHANICAL DEPARTMENT :—	
Electric Alarm and Pressure Gauge (<i>Illustr.</i>).—The Johnson Alarm Cash Drawer (<i>Illustr.</i>).....	17
A Large Siemens & Halske Armature Spider (<i>Illustr.</i>).—Transformer for Surgical and Dental Use. (<i>Illustr.</i>)—Prosperity of the Chicago Edison Co.—Improved Mechanical Trolley Clip of the New York Electrical Works. (<i>Illustr.</i>).....	18
Apparatus of the Columbia Telephone Manufacturing Co. (<i>Illustr.</i>).—Progress of the Thomson Electric Welding Method.—The Livgro Incandescent Lamp.—The Cleveland, Ohio, General Electric Co.—The New Stanley Catalogue.—Western Union Figures.....	19
New York Notes.—Western Notes.—New England Notes.—Philadelphia Notes.....	20

POWER TRANSMISSION AT THE PARIS EXPOSITION OF 1900.

FRANCE has gone through the agonies of a poignant grief during the past week, but her calmness and quick readjustment to normal conditions have once more evoked the admiration of the civilized world. To-day her government and her internal and external relations continue as smoothly as though her Chief Executive had not been stricken down by the assassin's knife, and it might even be said that the courage and spirit of the nation had been bettered by the sharp ordeal.

The late President Carnot was a civil engineer, whose courtesies many of our American brethren remember; and the nature of his profession inclined him to the methods and triumphs of peace. It was for this reason that he took so deep an interest in the Paris Exposition of 1900, and that during his last year of office the plans for it had been pushed so far forward. At the present juncture, amidst the excitement caused by his untimely death, it is a pleasant relief to turn to the reports of the meeting of the Exposition Commission, which has just taken place, and to learn that a general programme has already been drawn up, in which, naturally, electricity has a prominent place. But what is of greatest interest is the list already submitted of plans for special features of attraction. It will be remembered that the Chicago World's Fair was heralded by a great variety of engineering schemes and ideas of an unusual character, most of which died away in early oblivion, one or two of which were dismal failures, and one of which—the Ferris Wheel—was a pronounced success in all respects. We note among the plans for Paris, a proposition of merit from M. Armengaud, Jr., who, pointing out that previous expositions had been signalized by the exploitation of the telephone and the electric light, asks that in 1900 prizes of value be offered for three things, viz. (1.) Seeing at a distance; (2.) Photography in colors on paper; (3.) Electric light without heat. It will be admitted that all these three things, accomplished practically, would add greatly to the éclat of the Exposition; and the actual success already attained along each line affords encouragement. M. Trouvé, ever fertile and ready, has also suggested an electric light cascade falling from the third platform of the Eiffel Tower. It would certainly be a brilliant night spectacle.

We venture, however, to propose a scheme, of which we have seen no note thus far, but which would certainly interest not only all classes of engineers, but all concerned in railways, and the public at large. It is a familiar fact that among the most pressing problems of the day are those that relate to the electrical transmission of energy, and that at this hour some most important work is being done. Up to this time, however, the energy transmitted has been that of waterfalls, and all the plants under construction, such as that for Niagara, deal with water power. Now, a great deal has been said about burning the coal at the mine and transmitting its energy electrically instead of the fuel itself; and in England two well-known engineers, Messrs. B. H. Thwaite and James Swinburne, have worked out carefully the details of an electrical transmission to London of the energy of the coal fields of the Midlands and Yorkshire. What we propose is that

the Paris Exposition shall, in like manner, have all its power generated at coal mines now supplying Paris, and that this power shall be transmitted electrically.

The Chicago Fair made no demonstration of this kind. In fact, none has ever yet been made. The nearest approach to it was the remarkable water-power transmission of 100 miles, under the patronage of the Emperor of Germany, from Lauffen to the Frankfort Electrical Exhibition in 1891. Some idea of what is involved as to expense may be formed from the Thwaite-Swinburne plan of a 100 miles transmission of 10,000 h. p. of energy from coal, at a cost not to exceed, all told, £340,000; on which basis, according to Mr. C. E. L. Brown, small users of power in London could get 1 h. p. per annum for \$20. This plan contemplated the use of large gas engines at the generating points and a line potential of 30,000 volts. It is evident that all the apparatus, including line, would have considerable value after the close of the exposition. The Chicago plant for power reached about 20,000 h. p., and it is not likely that Paris would much exceed, if it equaled, this; so that taking the figures already cited, the initial total cost would not exceed £680,000 or \$3,400,000, and the investment in gas engines, generators, transformers and motors would certainly be a largely recoverable quantity, to say nothing of the value of the copper in the line, costing about \$500,000. Indeed, if the demonstration proved successful, the plant could be left intact for the daily supply of power to the various large and small industries of the city, it being safe to assume that such a quantity could very easily be marketed. We have no data at hand as to cost of power in Paris, but it is probable that the ordinary selling price of 1 h. p. is not below \$40 or \$50.

If such a plan as this be not carried out, the Exposition will still have to be furnished with its power in some way, and if resort be made to the ordinary methods there would be required for the 20,000 h. p. a large outfit of coal sidings, boilers, engines, shafting, machinery rooms, etc. By 1900, such methods will seem more dirty and antiquated even than now, but it might not perhaps be a bad idea as a compromise, to divide the power plant into two contrasting 10,000 h. p. units, one long distance transmission and the other that of generation *in situ*. The longer, bolder plan is that which appeals more to the engineering imagination, and one in the execution of which the authorities of the Exposition would probably enjoy very hearty advice, assistance and coöperation from French electrical engineering concerns, as well as others in America, England, Switzerland and elsewhere. If it be resolved to stick to water power, possibly the Exposition might be run by energy from the little sister Republic of the Alps, although by 1900 we shall all know a good deal about the working of such a plan, from the results obtained with Niagara.

ELECTROLYTIC COPPER.

It is scarcely more than ten years since the manufacture of electrolytic copper was begun on an extended scale in the United States, and yet it has already begun to be a most important, indeed, the controlling, factor in the copper market. When we consider the enormous quantities of high grade copper which can be obtained directly from the mines, such as Lake copper, this commanding

position of electrolytic copper is worthy of more than passing notice. Even those companies controlling mines with high grade carbonates have found it of advantage to enter the manufacture of electrolytically refined copper, and the great depositing plants at Anaconda, Baltimore, Newark, and elsewhere, are but forerunners of others of the same kind. The increased output of electrolytic copper has been followed by a steady fall in the price of Lake copper, in competition with it, and recent large sales of Lake copper at 9 cents per pound mark the lowest price for this metal which has ever been recorded, except during the panic of last year. It is believed in well-informed circles also that even this price will shortly be lowered. In discussing this aspect of the question, *The Iron Age* sees the main cause of this great decline in copper in the inability of consumption in this country to cope with the large production, it being estimated that the current consumption is somewhere between 60 and 70 per cent. of the normal quantity. This is an improvement over the second half of 1893, but still leaves America with a large exportable surplus. This, of course, serves to explain to some extent the low prices prevailing for copper of all kinds, but we think there is a further reason, which will account for the low price of electrolytic copper as compared with Lake copper. At first thought it seems hardly possible to produce electrolytic copper at a profit in competition with the latter, but when the fact is considered that almost without exception for every ton of electrolytic copper deposited, anywhere from fifty to several hundred dollars worth of gold and silver is obtained from the residual products, the reason for the low price of electrolytic copper becomes apparent. Indeed, under some conditions and with some qualities of copper ore, the electrolytic copper itself, considering its value alone, as compared with that of the more precious metal contained in the ore, might be considered a by-product. In substantiation of what has just been said we may cite the figures given by Mr. Titus Ulk6 in the "Mineral Industry," for 1893, the excellent annual published by the *Engineering and Mining Journal*. Samples of the "mud" remaining in the baths after the deposition of the copper at Anaconda averaged 35 per cent. copper, 45 per cent. silver and less than .2 per cent. gold. The Chicago Copper Refining Co. obtains about 3¼ lbs. of mud or slime from every 100 lbs. of copper anode. This slime contains 41.7 per cent. silver, and 1.3 per cent. gold. The Anaconda plant has a capacity of no less than 40 tons of electrolytic copper per day, from which it is easy to figure the amount of silver obtained in the working of the electrolytic process, taking the mud to average about 3 per cent. of the copper anodes treated. Cheap copper must react favorably on the electrical manufacturing industry and will also have a marked influence on power transmission work in this country. With bare copper at 10 cents a pound, as compared with 14 and 16 cents of but a few years ago, the cost of overhead conductors must necessarily be materially reduced, with the result of rendering practicable transmissions the cost of which heretofore was prohibitory. We believe that, thanks to electrolysis, copper will remain somewhere near present prices, even when the ground swell of the next tide of prosperity carries all prices forward.

ELECTRICITY AS A FIRE HAZARD.¹—I.

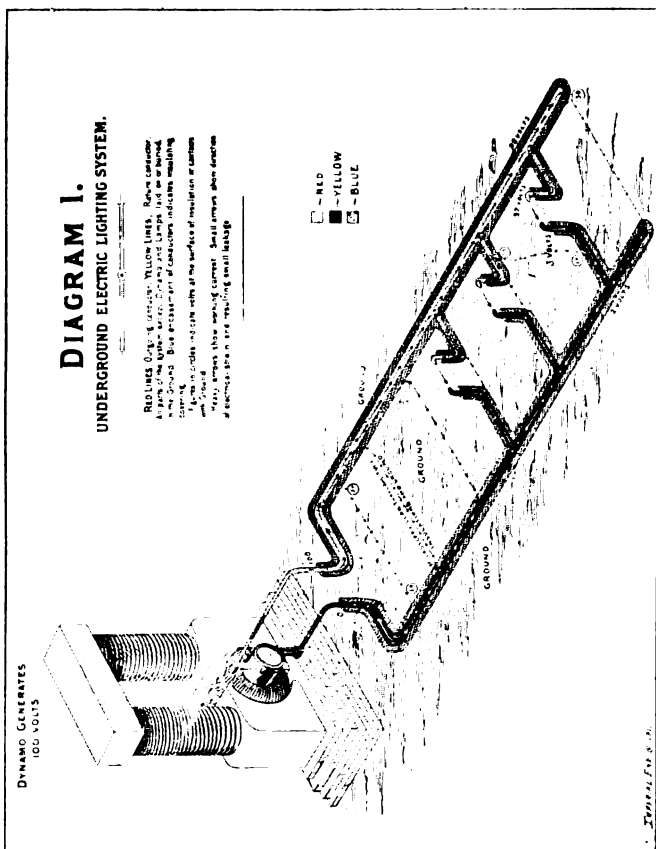
BY W. J. JENKS.

It is less than fifteen years since the attention of the fire insurance underwriters was first directed toward a class of hazards previously unknown to them, namely, the dangers to property attending the use of the electric currents necessary for the supply of electric lamps and motors distributed about the premises of the owner of a mill or a business block from an isolated electric plant, or more widely scattered in the stores or dwellings of many consumers supplied from a central station. There is a reason for this delay of the electrical fire hazard in putting in its appearance, and this reason lies at the foundation of an adequate conception of precisely in what that hazard consists.

PRACTICAL IMPORTANCE OF INSULATION.

If we assume a generator of electricity insulated from the ground by being placed upon proper non-conducting or high resistance supports, such as a wooden or brick base, and three electric lamps at a distance from the generator also placed upon such insulating supports as to prevent any material or serious leakage from their mechanism to the earth, and a covered outgoing conducting wire by which the current is taken from the dynamo and supplied to these three lamps simultaneously, so that a fraction of the entire current passes through each lamp, and if we suppose also that the three fractions of current are, after passing through the lamps, reunited and brought back to the generator by a return conductor also insulated, and that both the outgoing and return conductors are buried in the ground, we shall have a system of electric lighting in "parallel" or "multiple arc" which may be graphically represented by "Diagram 1—Underground Electric Lighting System."

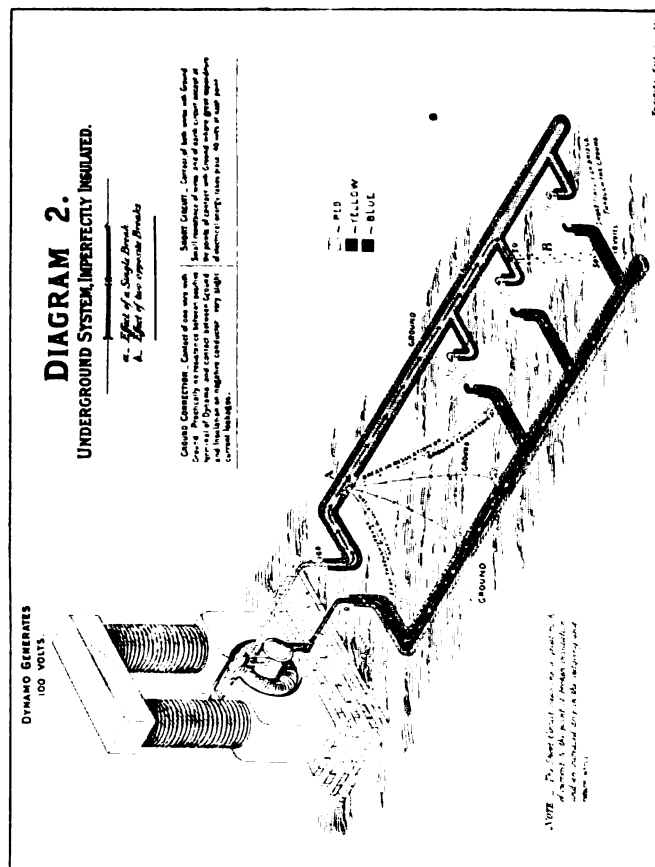
In this diagram the dynamo is assumed to deliver to the circuit a pressure of one hundred volts, and a fall or drop in pressure of two volts is supposed to be occasioned by the resistance of the red or outgoing wire, usually called the "positive" conductor. A further drop of one volt takes place in each "branch" on the positive side; each lamp usually absorbs 94 volts, each of the branches on the yellow or "negative" side causes a drop of one volt, and the large return conductor a further drop of two volts,



thus expending the entire pressure. The useful currents are indicated by heavy arrows and the lines of lighter arrows indicate the minute currents which, in spite of the resistance of the insul-

1. Abstract of a paper read before the Insurance Congress, Chicago, 1893. We are indebted to the *Investigator* (Chicago) for the accompanying diagrams.

ating covering of the wires, shown in blue in the diagram, leak or percolate through the insulation between the positive wire and the ground, through the ground to the surface of the negative covering, and through this covering to the negative wire itself, and back to the generator. Assuming that the cover-



ing is at all points of practically equal thickness and resistance, one-half of the total difference of pressure between two points on opposite conductors is expended in sending a minute current through the insulation of the positive wire, and the other half in taking the same current through the insulation of the negative wire, the resistance of the ground itself being so small that practically no part of the pressure is expended in passing from the outer surface of one insulation to the outer surface of the other. Thus, the pressure expended in the endeavor to break down the insulation of each wire of the system is about fifty volts, or one-half the pressure developed by the dynamo.

To illustrate some of the electrical effects which may occur in such a system as that of Diagram 1, when this electrical strain upon the insulators of the conductors develops "faults" or "breaks" in the insulating covering, and thus increases a minute leakage to one of greater magnitude, we may consider a second sketch, "Diagram 2—Underground System Imperfectly Insulated." This sketch illustrates two sets of conditions. At the left of the diagram the insulating covering of the positive conductor is shown to be so ruptured that the metal of the conductor and the ground are in contact, while no corresponding break appears in the covering of the negative conductor. The small arrows leading through the break and through the ground to four different points on the negative insulation, through that insulation to the negative conductor, and back to the dynamo, illustrate the strain which is, under these conditions, thrown upon the negative insulation, the surrounding earth being, so to speak, filled with electrical tension, seeking at all points to pierce and rupture the one remaining barrier which is interposed between the positive and negative poles of the dynamo by the covering of the negative wire. There being practically no resistance in that portion of the positive wire which is traversed by the leakage currents, and also practically none through the mass of the earth from the point of its contact with the positive wire to the outer surface of the negative insulation, the entire pressure of the dynamo, one hundred volts, is now exerted to break down an insulation resistance one-half as great as in Diagram 1. As the volts divided by the ohms gives as a quotient the amperes, it is plain that the expenditure in one thickness of insulation of twice as many volts, will result in a current of twice as many amperes, and this means the expenditure in actual energy

of four times as many volt-amperes or watts at each point of the negative insulation, and thus the development of four times as much heat and a far greater liability of a rupture of this negative insulation than before the positive break occurred. At the right of the diagram, the effect of two breaks, one on each side of the circuit, is indicated. We may here assume that the insulation is so broken down on the positive and also on the negative wire as to admit a great rush of current—that is to say, many amperes, and a consequent drop in pressure of ten volts on the positive, ten volts on the negative and forty volts at the point of contact between each of these wires and the ground; the resistance of the ground itself being practically of no consequence. Such an expenditure of voltage may practically indicate an instant transformation of many electrical horse power into heat at each point of leakage, and if the surrounding material be combustible, a fire may thereby be caused on each side of the system. Such a bridge of abnormal character between points where the insulating covering of the wires becomes broken, is usually called a "short-circuit," and the mischief which it may cause is often entirely independent of the amount of electrical energy which may be actually expended, though in cases where the mechanical power which is applied to the dynamo, and the capacity of the dynamo itself to maintain its normal pressure, even when a great amount of current is being generated, are both considerable, the actual heat developed by a short-circuit is sufficient to do a great amount of damage.

REACTANCE.¹

BY CHARLES PROTEUS STEINMETZ AND FREDERICK BEDELL.

THE term "reactance," which has been used and advocated by the writers and others and which has been officially adopted, at our suggestion, by the American Institute of Electrical Engineers at its Philadelphia meeting, is one which assumes particular importance now that the term "inductance" is defined as synonymous with the "coefficient of self-induction," usually symbolized by the letter "*L*." Reactance is a quantity similar in many respects to resistance, but the electromotive force used in overcoming reactance consumes no power, for it is at right angles to the current.

The impressed electromotive force in an alternating current circuit may be divided into two components: First, the *power electromotive force* in the direction of the current, and, second, the *reactive electromotive force* in quadrature with the current to overcome the reactance. The reactive electromotive force is the product of the current and reactance. The reactance is, accordingly, equal to the component of the impressed electromotive force at right angles to the current, divided by the current. Reactance is measured in ohms.

The reactive electromotive force in the circuit may be due to self or mutual induction, to capacity or to some outside counter electromotive force produced by a motor or other device. In general, in any alternating current circuit,

$$\text{Impressed E. M. F.} = \sqrt{\text{Power E. M. F.}^2 + \text{Reactive E. M. F.}^2};$$

that is, the impressed electromotive force is the vector sum of the electromotive force which transmits power and the reactive electromotive force.

Reactance tends to cause a phase difference between current and electromotive force. If θ represents this angle of phase, we have the relation,

$$\tan \theta = - \frac{\text{reactance}}{\text{resistance}}$$

When θ is negative, the current lags behind the electromotive force; when θ is positive, the current is in advance of the electromotive force. The expression for the instantaneous value of the current may be written,

$$i = I \sin(\omega t + \theta).$$

or

$$i = \frac{\text{Impressed E. M. F.}}{\text{Impedance}} \sin \left\{ \omega t - \arctan \frac{\text{reactance}}{\text{resistance}} \right\}.$$

A few illustrations of particular cases will make the use of the term reactance more clear.

Circuits Containing Resistance and Inductance.—In a simple circuit containing resistance and inductance, the reactance is equal to $L\omega$; that is, it is 2π times the product of the inductance and frequency. The impedance being the vector sum of the resistance and reactance is,

$$\text{Impedance} = \sqrt{R^2 + L^2 \omega^2},$$

where $\omega = 2\pi \times \text{frequency}$. In this case all the power is used in overcoming resistance, and the power electromotive force is equal to the ohmic electromotive force RI . The reactive electromotive force is equal to the inductive electromotive force $L\omega I$; hence

1. A paper presented at the close of the Philadelphia meeting of the American Institute of Electrical Engineers, May 18, 1894.

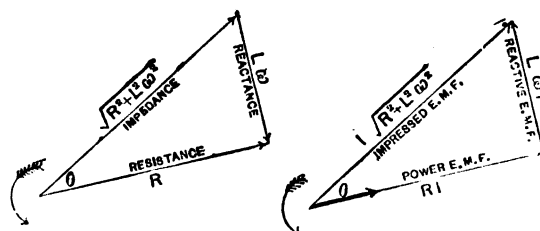
$$\text{Impressed E. M. F.} = \sqrt{\text{Power E. M. F.}^2 + \text{Reactive E. M. F.}^2};$$

or

$$\text{Impressed E. M. F.} = \sqrt{\text{Ohmic E. M. F.}^2 + \text{Inductive E. M. F.}^2}.$$

The impressed electromotive force in this case is the vector sum of the electromotive forces necessary to overcome resistance and inductance.

A consideration of Figs. 1 and 2 (in which positive direction is



FIGS. 1 AND 2.

counter clockwise) will show that the reactance and reactive electromotive force are *positive* in the case of a circuit containing inductance. The impressed electromotive force, which is the sum of the two, is therefore in advance of the current, which is in the same direction as the power or ohmic electromotive force. The current is indicated by a closed arrow in the figures. The same, however, may be otherwise expressed if we take the impressed electromotive force as our direction of reference, by saying that the *current lags behind* the electromotive force by the angle θ , which angle is negative; therefore, for circuits with inductance according to the relation,

$$\tan \theta = - \frac{\text{reactance}}{\text{resistance}} = - \frac{L\omega}{R}.$$

The value of the current at any instant is given by the equation

$$i = \frac{E}{\sqrt{R^2 + L^2 \omega^2}} \sin \left(\omega t - \arctan \frac{L\omega}{R} \right).$$

Circuits Containing Resistance and Capacity.—In such circuits the reactance is equal to $-\frac{1}{C\omega}$, where C = capacity, and $\omega = 2\pi \times \text{frequency}$, that is, it is negative. The reactive electro-

motive force is also negative, being equal to $-\frac{I}{C\omega}$. This negative

reactance gives a positive value to the angle θ , and the current is accordingly in advance of the electromotive force. We have then

$$\text{Impedance} = \sqrt{R^2 + \frac{1}{C^2 \omega^2}},$$

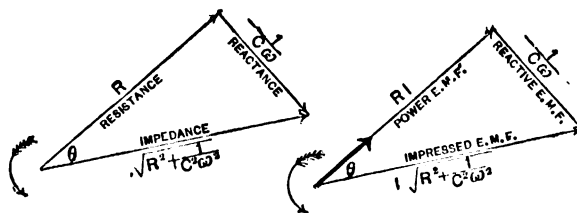
and

$$\tan \theta = - \frac{\text{reactance}}{\text{resistance}} = + \frac{1}{CR\omega},$$

similar to the corresponding equations above. The instantaneous value of the current is given by the equation

$$i = \frac{E}{\sqrt{R^2 + \frac{1}{C^2 \omega^2}}} \sin \left(\omega t + \arctan \frac{1}{CR\omega} \right).$$

These relations are shown in Figs. 3 and 4.



FIGS. 3 AND 4.

Circuits Containing Resistance, Inductance and Capacity.—In a circuit containing inductance and capacity the reactive electromotive force is the sum of the inductive electromotive force and the condenser electromotive force; that is, $L\omega I - \frac{I}{C\omega}$.

The reactance is similarly the sum of two terms, $L\omega - \frac{1}{C\omega}$; thus, the reactance is positive or negative, according to whether the in-

ductive electromotive force is greater or less than the condenser electromotive force. Whether the current is behind or ahead of the impressed electromotive force depends upon the same condition, for

$$\tan \theta = -\frac{\text{reactance}}{\text{resistance}} = \frac{1}{CR\omega} - \frac{L\omega}{R}.$$

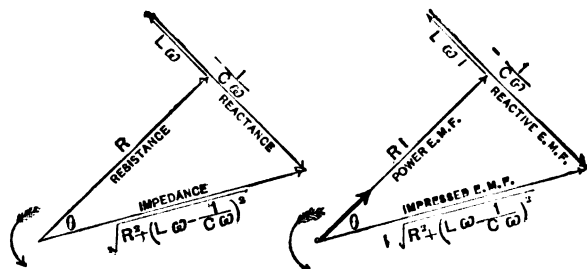
The value of the current at any instant is

$$i = \frac{E}{\sqrt{R^2 + \left(L\omega - \frac{1}{C\omega}\right)^2}} \sin \left\{ \omega t + \arctan \left(\frac{1}{CR\omega} - \frac{L\omega}{R} \right) \right\}$$

The diagrams in Figs. 5 and 6 illustrate the case of a single circuit containing resistance, inductance and capacity. In the case here represented, the condenser electromotive force is greater than the inductive electromotive force, and the current is therefore in advance.

Circuits Containing Mutual Induction.—To further exemplify the use of the term reactance, let us consider a circuit containing a transformer. Besides the electromotive forces already discussed, we must consider the back electromotive force due to the influence of the secondary upon the primary circuit. This may be resolved into two components, one in the same direction as the current, and the other in quadrature with it, which will form part of the power electromotive and reactive electromotive forces, respectively. The electromotive force introduced by a motor is treated in the same way.

These illustrations will suffice to show the method by which any electromotive force in a circuit is resolved into two components, one in the direction of the current, which therefore transmits power, and the other at right angles to the current, which represents no power but simply overcomes the reactance.



FIGS. 5 AND 6.

It is to be borne in mind that the terms here given may be used in all alternating current circuits, whether the current is harmonic or not; for, when the current is not strictly harmonic, we may consider it equivalent to an harmonic current. The equivalent harmonic current and equivalent harmonic electromotive force have the same square root of mean square values as the actual current and electromotive force, and have such relative phase positions that the same power is transmitted.

THE EXPERIMENTAL SEARCH LIGHT AT SANDY HOOK.

The great electric search light recently erected at the Government Proving Grounds at Sandy Hook is the largest of those exhibited by the Schuckert company last summer on the Manufactures and Liberal Arts Building at the Fair, though it is hard to recognize it in its present position. Standing, as it now does, alone on the top of a slender looking wooden tower less than 100 feet above one's head, it seems much larger than it did at the Fair, and, besides, it has been somewhat modified to suit the special conditions of the service to which it is to be put. The readers of THE ELECTRICAL ENGINEER have been interested in the short articles that have recently appeared in the newspapers describing the Government tests of the light in coast defense and signal work, and will, doubtless, be glad to learn something of the method of operating the light in its new position.

The generating plant is exceedingly compact and occupies a small room in one of the machine shops about 450 feet distant from the tower. It consists of a four-pole Schuckert compound dynamo delivering a current of 170 amperes at 70 volts, directly connected to a 20 H. P. marine engine built by C. Daewel, of Kiel, and running at 450 revolutions a minute. Just back of the dynamo is its switchboard, equipped with Schuckert instruments,—rheostat, voltmeter, ammeter, automatic switch and safety devices.

The light stands on a wooden tower sixty feet in height built upon a thirty-foot granite wall at an angle of some condemned fortifications, and is just 100 feet above the sea level. Two 0000 cables from the dynamo switchboard lead to the lamp switchboard at the top of the tower and thence to the light itself. This board is protected from the weather by being placed in a little closet at

the top of the last flight of steps and just below the floor on which the projector rests, and contains a resistance to regulate the current, a voltmeter, an ammeter and a cut-out switch.

The base frame of the lamp is bolted to heavy timbers at the top of the tower and supports the turning table, which, in turn, carries the lamp by means of the two side arms with trunnions for vertical motion. Mechanism is provided for moving the drum in all directions by hand or electrically from a distance, as desired. The lamp is placed horizontally in the drum with the carbon points in the focus of a parabolic reflector with an efficient diameter of 150 cm. This is of glass with both surfaces ground and polished to true paraboloids and the back heavily silvered. Its total diameter is about 160 cm. The lamp works automatically, as well as by hand, and takes a current of 150 amperes at 60 volts. The remainder of the dynamo output is accounted for by drop in the line and the amount required to operate the small motors that turn the drum. The positive carbon is 1½ inch in diameter and the negative 1 inch, and the lamp is self-focusing, though the focal distance may be varied at will.

The lamp itself is of 57,000 c. p. The rays actually impinging upon the mirror are calculated at 45,000 c. p. while the intensifying power of the mirror is 4,311, making the total brilliancy of the beam of light as it issues from the projector, 194,000,000 c. p. The light has been tested by the jury of awards at both the Frankfort and Chicago Exhibitions, and the results of both sets of experiments agree with these figures, which were obtained by the Schuckert company.

The face of the drum is provided with a plane glass, a set of dispersing lenses and a signaling device. The dispersing lenses are vertical plano-convex strips about two inches wide fitted closely together in a frame to disperse the rays horizontally, while the signaling device consists of a set of blackened metal shutters so placed that each slat, when open, stands exactly in front of the line between two strips of the diverging lens, and, therefore, does not interfere with the passage of light. This shutter is operated by hand and flashes the Morse code by simply interrupting the beam for long and short intervals, representing dashes and dots respectively.

With the exception of this signaling device the light may be operated from the observation house, standing on the wall of the fort below the tower and containing a Schuckert long distance electric governor controlling the vertical and horizontal rotations of the drum by means of two small motors in its base.

The light was placed and wired by Mr. F. Tischendoerfer, electrician for Schuckert & Co., who had charge of their exhibit at the Fair.

LITERATURE.

An International System of Electro-Therapeutics: for Students, General Practitioners, and Specialists. By Horatio R. Bigelow, M. D.; and Thirty-eight Associate Editors. Philadelphia, 1894. The F. A. Davis Co. Thoroughly illustrated. 1160 pages. 6 x 9½ inches. Extra Cloth, \$6.00; Sheep, \$7.00; Half-Russia, \$7.50.

The interest in electro-therapeutics seems to be rapidly increasing, in this country, at any rate. Books and contributions to the medical journals on the subject frequently appear. The electrical journals find it necessary to acknowledge electro-therapeutics as a regular branch of applied electricity, and the American Electro-Therapeutic Association is strongly in evidence. Such being the case, the book under review appears at an opportune moment. It is a valuable addition to electro-medical literature and can hardly fail to find its way to the libraries of many physicians and not a few electricians.

The author has thought well to use the word "International" in the title, and therein is too ambitious, for the contents scarcely bear out the inference one naturally draws from the word. Of the 39 articles contained in the book quite 75 per cent. are by American writers and France supplies half the remainder. Of German articles there are none and of English only two. It may be that the number of competent electro-therapists in America is as largely in excess of that of the rest of the world in the aggregate as this book appears to suggest but we have some doubts about it. England is notably backward on this subject, but Germany, Austria, Russia and even little Holland possesses living electro-therapists whose names are a guarantee of honest scientific work of the highest order and whose contributions might well have been substituted for some of those supplied by Americans of less eminence. Of course such men may have been asked and declined to contribute, but that does not form sufficient excuse for the word international.

Of the book as it stands there is much to be said both of praise and blame. Speaking generally the conception is good but the execution leaves much room for criticism. For instance, there is an excellent article by Prof. A. Wilmer Duff upon the fundamental electro-physics, which the editor doubtless intended to stand as the one basis leading to the superstructures of the other writers in electro-therapeutics proper. This, some of the other

contributors do not seem to have been aware of or deliberately overlooked, and have gone over much of the same ground again. Thus overloading the book with needless repetition and, in some instances showing considerable looseness and even ignorance in what they presume to instruct and enlighten others upon. Again, while the book contains much that is interesting, much that is valuable and a few things which are new, it also contains much that is unnecessary, to our thinking at least, much that is feeble and not a little that is pure padding.

We should like to give at least a glance at each article in turn, but space forbids. We can only refer briefly to a few. The preface, we presume by Dr. Bigelow, is chiefly remarkable for the long quotation from an English writer, who has lately taken high place as an authority on electro-therapy, Dr. W. S. Hedley, which exhibits a grasp of electro-physics which few medical writers possess. It is matter for regret that the book contains no direct contribution from his pen. The table of reference for named makes of batteries, instruments, etc., is useful but hardly so clear as it might be. Dr. Herdman's introduction, on "the necessity for special education in electro-therapeutics," is most valuable and can hardly be spoken of too highly. Would that every medical practitioner or other person tempted to *try electricity* upon some unfortunate victim may read it and take it to heart! Prof. Duff's article on "Electro-Physics" is concise and to the point. His statement that "Electricity is a Thing" is not of much help in explaining what electricity is, but the expression has its value when he goes on to say that electricity is a thing "because it is conserved." He appears to favor the theory that there are two kinds of electricity, for his article concludes as follows:—"Since, then, the ether is somehow intimately connected with electricity, and there are probably two kinds of electricity, it may be that the two electricities co-exist in the ether in somewhat the same way as hydrogen and oxygen exist together in water. When one goes in one direction the other goes in the other direction, like the precession of ions in the electrolysis of a liquid. In a dielectric there is difficulty in separating the components, and even when separated a short distance they will spring back, thus giving the dielectric the elastic property to which we have several times made reference. If too far separated they do not return, but fly apart, causing what we call a disruptive discharge. Again, in a conductor, the bonds connecting the two constituents are somehow relaxed, so that they are readily separated. This, however, is merely a guess quite unverified, but looking very plausible."

Dr. Mills' article on "Animal Electricity" is disappointing, for it does not touch the question of electric generation in the human body. Dr. Engelmann in his article on Faradic or Induced Current wisely lays stress upon the need for a suitable instrument to measure the small coil and other alternating currents used in electro-therapeutics. Surely electrical instrument makers will not long allow the want to remain unfilled!

Dr. Davis' contribution on "Electro-Therapeutics of Diseases of the Lungs and Heart" may be all very good as a description of the symptoms of this class of disease but there is very little electro-therapeutics about it. No less than nine articles are devoted to the treatment of diseases peculiar to women and they may be further described as elaborations of Apostoli's methods. Those contributed by Dr. G. Britton Massey and by Dr. Augustin H. Goelet are the best. Dr. W. J. Morton discourses, in a masterly manner, upon "Diseases of the Spinal Cord." His table showing the "Approximate Relation to the Spinal Nerves of the Various Motor, Sensory and Reflex Functions of the Spinal Cord" is an ingenious arrangement and will probably be found a great aid to those who try to carry out his suggestions in regard to the local electrization of spinal cord lesions. We regret that space forbids more than a mere mention of Dr. Morton's theory of the Polarity of Metabolism. It is a grand conception and if it stands the test of experience will be regarded as one of the greatest advances in electro-therapeutics that this active scientific age can record.

In conclusion we may say though this book is far from perfect it has much to recommend it. To the electrician it marks a period of great electro-therapeutic development and the physician will do well to use it as a work of reference.

H. NEWMAN LAWRENCE.

LETTERS TO THE EDITOR.

THE CALORIMETER IN BOILER TESTS.

I should like to suggest to your correspondent, "R. S. Hale," whose letter appeared in your issue of June 6, that there is, in the science of calorimetry something quite as important as the manipulation of the instruments,—I mean the selection of a fair sample of the steam to be tested. If a few drops of water, insignificant as compared to the total volume of steam, get into the pipe leading to the calorimeter, the deluded observer of that trusted instrument begins to collect evidence that enables him to "bear witness that on occasion a Babcock and Wilcox boiler will prime ten to twenty per cent.," and these phenomena are not con-

fined to Babcock and Wilcox boilers nor is the per cent. of priming limited.

I believe that condensation in the steam pipe is largely, if not entirely, responsible for these abnormal results. Time and again I have seen the thermometer of a throttling calorimeter drop to 212 degs. just at the moment when the steaming of the boiler had been slightly checked, as, for instance, at the time of firing. If there is any condensation in the pipe it will be at just such times that it will flow back to get measured.

E. H. PEABODY.

NEW YORK, June 27, 1894.

BUS BAR OR SELF-EXCITATION FOR RAILWADYNAMOS.

To the large circle of intelligent readers of your valuable paper, which I believe includes the men of the highest standing in our profession, an article that is purely personal, and at the same time devoid of scientific argument, statement of fact or news must be particularly uninteresting.

If Mr. Herrick had occupied the time he spent in preparing his letter of last week, in setting forth his reasons for the statement that, "The combined method of field excitation falls short of the object sought," and "It is evident that the potential of the bus exists between two adjacent field switch terminals after the equalizer switch has been thrown," his letter would have been of more interest to your readers in general, including the writer.

Until some argument is forthcoming, other than the advice from a junior, "To take the trouble to investigate the practices of station managers," I have nothing to add nor retract from my first article on field excitation. On this point I might add that my experience with station managers has been long and varied, dating back to the early days of the industry, when there was but one station and, consequently, only one station manager.

The diagram of connections illustrating Mr. Potter's article, in your issue of June 13th, is identical with one designed early in 1893 by Mr. Frank Bourne and myself, for the Trenton Passenger Ry. Co.; since which time this construction has been giving entire satisfaction in Trenton, N. J., and other places where I have installed switchboards, using only single pole apparatus; and I am pleased that the system has the endorsement of Mr. Potter, and has been adopted by the General Electric Co., as I believe it embodies every advantage of the more cumbersome and less reliable method of using three pole switches and a great complexity of connections.

If the above contains no news of general interest, it at least attacks no one, and I ask your indulgence.

C. S. VAN NUIS.

NEW YORK CITY, June 23rd, '94.

SOCIETY AND CLUB NOTES.

NORTHWESTERN ELECTRICAL ASSOCIATION.

SECRETARY H. C. THOM, Madison, Wis., writes us:—

The summer meeting of the Northwestern Electrical Association will be held in St. Paul July 18th, 19th and 20th. There is excellent promise of a large meeting. At the last meeting, held in Milwaukee, one hundred and fifty were present, and a larger number is expected at this meeting. Representatives from Illinois, Iowa, Michigan, Wisconsin, and North and South Dakota, have written that they will be present. An excellent programme has been prepared, and the best expert and electrical talent of the United States has been secured to address the convention. Current will be furnished to illustrate lectures as well as to accommodate exhibitors. Manufacturers and supply houses will be accorded every courtesy by the Association.

RICHMOND ELECTRIC CLUB.

The "Richmond Electric Club" is now occupying its neat and newly fitted rooms 909 Bank St. This club is young but it is composed of skilled electricians or those in kindred professions. The next regular meeting is to be held on Monday, 4th June. President, G. A. Tower; vice-pres., T. L. Martin; sec., H. Table.

COLLEGE NOTES.

WEST VIRGINIA UNIVERSITY.

PROF. A. R. WHITEHILL, who fills the chair of chemistry and physics at the West Virginia University, Morgantown, W. Va., informs us that the University is about to establish a course in electrical engineering, and is now erecting a laboratory, etc., for that special purpose.

YALE UNIVERSITY.

At the commencement exercises on June 27th, Yale University conferred on Mr. Nikola Tesla the honorary degree of M.A. It will be remembered that Columbia College made Mr. Tesla an LL.D. two weeks ago.

LEGAL NOTES.

AN IMPORTANT SUBWAY DECISION IN NEW YORK.

THE New York, Broadway and Seventh Avenue Railroad Company has won its fight with the Empire City Subway Company, Limited, in regard to its right to use the conduit running along its line of road from the Battery to Fifty-first street for its own signal wires. Judge Ingraham holds that the Empire City Subway Company has no right to maintain an action to enjoin the railroad company from maintaining electrical conductors in its conduit for the necessary and proper operation of its road, and has no exclusive right to maintain subways in the streets; and that the railroad company has not infringed upon the franchise owned by the subway company.

The subway company, claiming the exclusive right to the operation of the subways in the city, brought this suit to enjoin the railroad company from using the conduit along the line of its road for the use of wires to be devoted to signalling in case of accident, so that the cable might be stopped. It was set up that the railroad company should have applied to the Board of Electrical Control for permission to lay wires. Judge Ingraham says that it could not have been the intention to authorize the company to operate a railroad by means of a cable, and then not allow it to make provision for operating it safely.

Judge Ingraham holds further that the license of the Empire Subway Company is not an exclusive right to maintain subways in this city, and that this complaint must be dismissed. He states that the subway company would have a cause of action against the railroad company if it allowed the subways along its line of road to be used by others to the injury of the subway company, but that no such injury will result from the use of the subway by the railroad company for the orderly and proper operation of its own railroad.

INJUNCTION DISSOLVED IN DETROIT AS TO ELECTRIC LIGHT TOWERS.

THE petition of the Detroit city lighting commission for a dissolution of the temporary injunction forbidding them to buy the towers belonging to the Detroit Electric Light & Power Company was heard by Judge Lillibridge on June 23. Col. Sellers appeared for the Jones Tower Co. in opposition. The city was represented by Counselor Speed; the electric commission by E. F. Conely. Col. Sellers claimed that the electric commission had so worded the specifications for bids, that only the Brush Company or others holding Adams' patents could compete. This he held to be contrary to public policy. The city had already condemned these towers as dangerous and the commission had agreed to pay \$525 for old dangerous towers, when they could get new ones for \$500. In reply to the argument on the other side that the supreme court of Michigan had ruled in the case of the Nicholson pavement that the common council had a right to frame its bids without reference to the claims of competing concerns, Col. Sellers replied that there was at that time only one acknowledged wooden pavement—the Nicholson—and consequently no competition.

Judge Lillibridge dissolved the injunction. A permanent injunction will be asked for, it is said.

RAILWAY RIGHTS OF THE POSTAL CO.

A VERY important decision has been rendered by Judge Hawkins, at Prescott, Ari., on a petition of the Postal Telegraph Company, to the court having jurisdiction over the receiver of the Atlantic and Pacific Railroad in Arizona, to compel the latter company to extend to the former the right of way along its tracks and render other assistance necessary in building the telegraph line through Arizona. The decision was in favor of the telegraph company.

BELL TELEPHONE STOCK LEGISLATION.

Govr. Greenhalge, of Massachusetts, has vetoed the bill just passed, increasing the American Bell Telephone capital to \$50,000,000, on the ground that the bill exempts it from the ordinary and regular legal restrictions and safeguards established by the present policy of the Commonwealth; but has approved another, which puts the new stock open to public purchase instead of restricting its sale to existing stockholders.

PERSONAL.

GEN. B. F. PEACH has resigned as treasurer of the General Electric Co.

AN ACCIDENT TO MR. EDISON.

While at Ogden, N. J., recently Mr. T. A. Edison sustained injuries from a fall off the porch of the house in which he has been living there, while at work on his ore separation process. At first, no anxiety was felt, but on his arrival home at Orange, serious com-

plications arose, and physicians were summoned. By last reports, Mr. Edison was better, but it will be some time before he is quite well again.

REPORTS OF COMPANIES.

FINANCIAL PLANS OF THE UNITED ELECTRIC LIGHT AND POWER CO.

The United Electric Light and Power Company, of New York, has issued a plan for funding its debt and for procuring new capital for extensions, etc., under which there will be issued \$4,000,000 common stock, \$2,000,000 6 per cent. cumulative preferred stock and \$5,000,000 5 per cent. gold bonds. Creditors will receive for every \$1,000 of debt \$1,000 in 5 per cent. bonds, \$200 in preferred stock and \$300 in common stock. It is also proposed to raise \$1,000,000 fresh capital for new machinery, extensions, etc., by the sale of additional bonds and stock. The following Directors have been elected: Charles Francis Adams, August Belmont, C. J. Canda, Paul D. Cravath, Marcellus Hartley, G. W. Hebard, Henry B. Hyde, Brayton Ives, C. H. Jackson, Ph. Ferd. Kobbe, D. D. Parmley, James Stokes and George Westinghouse, Jr.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JUNE 19, 1894.

Dynamos and Motors:—

Armature for Dynamo Electric Machines, E. W. Rice, Jr., Schenectady, N. Y., 521,671. Filed Apl. 19, 1894.

Relates to the spiders used to support the core discs. A ring of diamagnetic material is provided with projecting arms having dove-tailed ends and lugs projecting from each side of the arms adapted to engage with devices for keeping the core discs in place.

Lamps and Apparatuses:—

Electric Lamp for Bicycles, G. Mayr, Brooklyn, N. Y., 521,721. Filed Nov. 7, 1893.

Employs a dynamo mounted upon the bicycle.

Measurement:—

Electric Meter, E. Thomson, Swampscott, Mass., 521,685. Filed Feb. 21, 1894.

An improvement upon the electric meter patented to the same inventor in No. 448,894. Claim 1 follows:—The method of energizing an initial or starting field for an electric meter, which consists in feeding a coil adapted to provide such a field by induction from an armature circuit in shunt to the main supplying the current to be measured.

Meter for Recording Measurements of Electric Power, E. Thomson, Swampscott, Mass., 521,684. Filed Jan. 31, 1894.

Further improvement upon the meter of patent No. 448,894, adapting it for use upon the "series-multiple" or "three-wire" system of distribution.

Miscellaneous:—

Lamp Lighter, A. H. Todd, Senatobia, Miss., 521,516. Filed Aug. 8, 1893.

An electric lighting device portable with a lamp. Includes a galvanic battery.

Electric Belt, E. M. Miles, Chicago, Ill., 521,594. Filed July 1, 1893.

Alternating Current Regulator, O. Offrell, Middletown, Conn., 521,666. Filed Dec. 12, 1892.

Employs the counter electromotive force, developed in a helix, to oppose the current flowing into the translating device.

Railways and Appliances:—

Electric Railway Signal, C. R. Alsop, Middletown, Conn., 521,455. Filed Oct. 12, 1893.

Of the type employing contact devices operated by the wheels of a passing train.

Electric Railway Signal, B. Samuels, St. Joseph, Mo., 521,553. Filed July 26, 1893.

Devices whereby the engineer of a moving train will automatically receive a warning signal apprising him of the condition of the track ahead.

Conduit Electric Railway, T. Armat, Washington, D. C., 521,562. Filed Mch. 28, 1893.

Employs an insulated supply conductor, centrally supported in the conduit, and a series of rocking frames carrying metallic strips as sectional conductors, the frames being actuated by a current gatherer on the car.

Trolley Pole Catcher, O. G. Cates, Jr., St. Louis, Mo., 521,602. Filed Mch. 12, 1894.

Releases the tension of the trolley supporting frame upon the escape of the trolley wheel from the conducting wire.

Electric Railway Car Motor, J. C. Henry, Westfield, N. J., 521,651. Filed Aug. 25, 1892.

Claim 4 follows:—

An electric motor having a multipolar armature with alternating pole pieces of constant polarity, a shunt wound multipolar field magnet, a two-pole pole-changer in the field circuit, and gearing for rotating said pole-changer in a ratio equal to one-half the number of pole-changes to be made in one revolution of the armature.

Supply System for Electric Railways, T. H. Harris, Detroit, Mich., 521,711. Filed Apl. 23, 1893.

Employs electro-magnetic devices for effecting contact with the working conductors.

Telegraphs:—

Printing Telegraph, E. Pope, Quebec, Can., 521,550. Filed June 20, 1890.

Employs a series of twenty-eight electromagnets, each capable of operating either of two type-levers, thus securing fifty-six different characters.

Telephones and Apparatus:—

Combined Annunciator and Spring Jack, H. M. Fiek, Chicago, Ill., 521,461. Filed May 14, 1894.

Designed for telephone exchanges. The insertion of a connecting plug automatically restores subscriber's annunciator drop.

Telephone Switch, A. Stromberg and A. Carlson, Chicago, Ill., 521,514. Filed Jan. 26, 1894.

Switch is located in or upon the receiving telephone, in position to be closed conveniently by the hand.

Trade Notes and Novelties AND MECHANICAL DEPARTMENT.

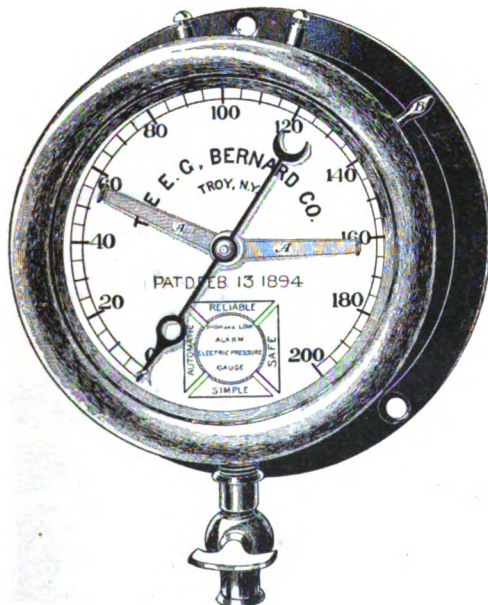
ELECTRIC ALARM AND PRESSURE GAUGE.

THE object of this device, manufactured by the E. G. Bernard Co., Troy, N. Y., is to provide an electric alarm signal for high or low pressure, that can be attached to all forms of pressure gauges. At the same time, it is provided with a simple means of testing the gauge to see if it is in working condition at all times, and also at the same time to test the signal bell or recorder. It can be attached to both the signal bell and to the recording clock and thereby give at all times a record of the pressure when it exceeds certain limits either high or low.

The engraving, Fig. 1, is a plain view of the face of the common form of a pressure gauge, provided with the attachments. The small handle or finger B, by being pressed either up or down, will test the gauge in either direction for high or low alarms, thus showing that both the gauge spring and the electric signal apparatus are in perfect order, and thus doing away entirely with any distrust of the apparatus. Any device of this kind, which cannot be easily and constantly tested and which is required to work automatically, is always held in distrust, since a failure to work at any time is invariably due to the fact that there is no reliable way of testing it, to insure its being always in readiness at a critical moment. This has made them of little value. In the present case it can at once be seen whether the apparatus is in perfect working order or not.

This gauge is of special value on the sprinkler system. On the wet system of automatic sprinklers it is of the utmost importance, as very often a defective head or other leak in a sprinkler system will start, or a fire cause a single head to go off and put out the fire. This one head or leak would not be sufficient to move the 4 or 5 inch check valve, to which the mechanical gong is attached, far enough to cause a positive alarm. This failure to work has caused more damage by water than fire, before the leak is discovered. This gauge can be set within one pound, if desired, of the pressure which is normally carried, thus indicating a leak at once.

There is also trouble in the wet system from overpressure, due to changes in the temperature, which cause the water in the pipes to expand and thereby increase the pressure considerably above that desired and sometimes forcing a head, as the check valve; while it will allow water to come in when the pressure is reduced, will not allow water to go out when the pressure is increased by expansion.



ELECTRIC ALARM AND PRESSURE GAUGE.

In dry systems it is of the utmost importance, because when a head goes off, the air has to escape from the pipes before the water can be of any service and thus many valuable seconds are lost before the alarm is given, and the first few seconds of a fire are the most valuable time, and worth hours afterwards. The gauge is so arranged that as soon as the head is opened and the air commences to escape, it will ring a bell long before the water will come through the pipes. As a valuable help and assistance to the sprinkler systems, this gauge is, therefore, of the highest importance.

It is also a valuable gauge to be used on a steam boiler, as very often the engineer or fireman has something else to attract his attention for a short time and in that time the steam pressure either rises or falls, particularly on small plants and house-heating apparatus, as the person who attends to the boiler generally has other work to do and cannot watch the boiler. The gauge can be adjusted so as to give both high and low alarms between any two points desired.

THE JOHNSON ELECTRIC ALARM CASH DRAWER.

AMONG the various applications of electricity in the mechanical arts, the Johnson Electric Alarm Cash Drawer, illustrated here-



THE JOHNSON ELECTRIC ALARM CASH DRAWER.

with, is one of the latest examples. It consists of an ordinary cash drawer, but instead of the usual mechanical bell alarm, an electrical device is made use of for that purpose, consisting of a dry battery, a bell, an electric lock and the combination of five contact keys connected in multiple with the circuit. The combination is easily changed and the keys set are externally indistinguishable from those not set. If the proper keys are touched, the circuit is broken in the combination and the drawer may be opened without any noise. If, however, the proper keys are not depressed, the bell will ring, and the drawer will lock if an attempt is made to open it. The drawer will also lock itself if left partially open, and while in this position, the bell will ring continuously. In addition to the local alarm, connection can be made from the switch and bell to any part of the building, so as to act as a night alarm.

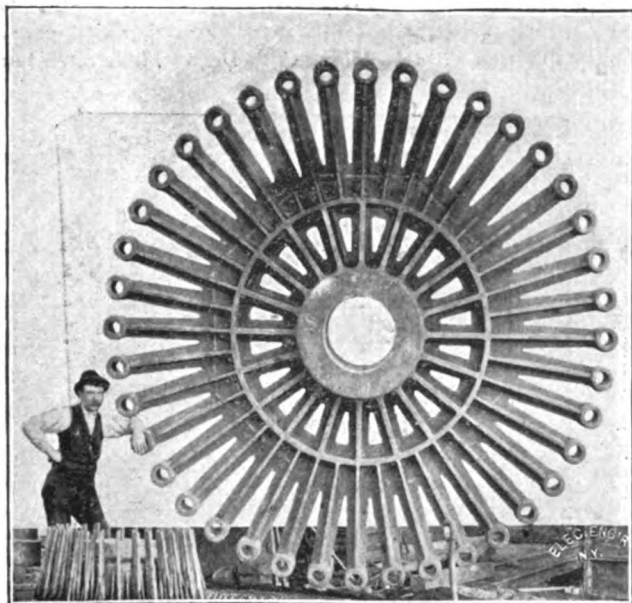
This alarm cash drawer is constructed on entirely new ideas, and contains many novel and desirable features. It is manufactured by the Western Electric Company, 227 S. Clinton street, Chicago, and Thames and Greenwich streets, New York.

MR. HENRY G. ISSERTEL, well-known to the electrical trade has recently joined the forces of the H. W. Johns Mfg. Co., and will represent them as selling agent, devoting his time especially to the pushing of their large variety of electrical insulating specialties for dynamo, motor and railway work.

A LARGE SIEMENS & HALSKE ARMATURE SPIDER.

THE accompanying engraving represents one of a pair of probably the largest armature carriers or spiders in the world. A pair of them have recently been made by the Wells and French Company for the Siemens and Halske Electric Company of America, who will install them at Toronto, Ontario, for street railway service.

The machines when completed will weigh about 60 tons each



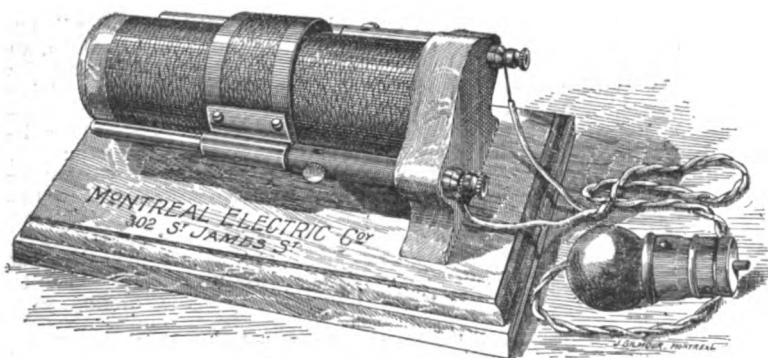
A LARGE SIEMENS & HALSKE ARMATURE SPIDER.

and have a nominal capacity of 1,200 KW. or 1,600 H. P. each, under 500 volts pressure, and will be overcompounded for 12 per cent. drop in the lines. They are to be direct connected to a pair of horizontal cross compound condensing engines, making 80 turns per minute.

The armature carriers are 18 feet in diameter and weigh something over ten tons each. The brush carriers will be about 14' 6" in diameter, being made by the same firm. The castings came from the mould absolutely perfect, without a warp, crack, flaw or blow-hole and are now being finished for the armature. Considering the form and size and the difficulty in making these castings, the Wells and French Company are to be highly commended for their skill and workmanship in turning out such perfect work successfully on their first order of this kind.

TRANSFORMER FOR SURGICAL AND DENTAL USE.

THE accompanying illustration represents a transformer for converting the ordinary 52-volt alternating current into one of



TRANSFORMER FOR SURGICAL AND DENTAL USE.

low pressure and large quantity for heating cautery tips and illuminating small examining lamps for doctors and dentists. It is designed to replace the storage and primary batteries usually employed for such purposes, which require considerable attention to keep in good condition and are liable to get out of order when most needed.

The transformer can be attached to any lamp socket by a plug and cord, and consists essentially of a primary coil, which is thus connected with a source of alternating current. Around the coil is a movable secondary coil mounted upon two nickel-plated rods which are parallel to the primary. The secondary is composed of a few turns of thick copper wire whose terminals are connected electrically with the rods by means of springs. The cautery or lamp is connected with the secondary coil by a flexible cord, the ends of which are inserted in binding posts in the rods. The strength of the current is varied by sliding the secondary coil along the rods and in this way can be easily regulated as desired. Another form of the transformer is made, having two secondary coils mounted upon independent pairs of rods. This instrument can give two separate currents of different strengths at the same time.

These transformers are compact and can be carried in a small hand bag. A further advantage they possess over batteries is that the expense of running is very small, for as a cautery or examining lamp is used for but a few moments at a time it is evident that the cost of the current consumed during the brief periods of use will be trifling.

These simple and convenient instruments are being put on the market by the Montreal Electric Co., of 802 St. James street, Montreal, Canada.

PROSPERITY OF THE CHICAGO EDISON CO.

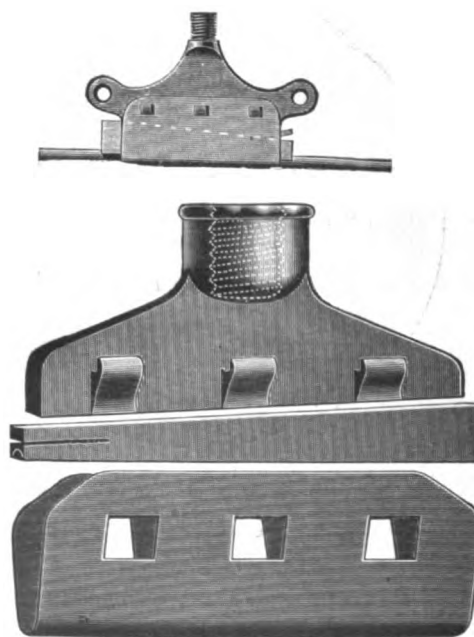
PRESIDENT SAMUEL INSULL of the Chicago Edison Company reports for 15 months ended March 31, 1894, gross income of \$2,141,779 and net of \$680,676. Interest and dividends, etc., consumed \$426,416, and \$254,260 was carried to surplus. The capital stock has been increased to \$4,200,000 to provide for large extensions.

IMPROVED MECHANICAL TROLLEY CLIP OF THE N. Y. ELECTRICAL WORKS.

THE accompanying cuts illustrate an improved trolley wire hanger or mechanical clip, patented and manufactured by the New York Electrical Works.

The object of this form of clip is to secure a mechanical grip upon the trolley wire without bending or marring the latter, and to obtain this result by a device which can be easily applied, and quickly secured and which is capable of partial or complete removal and repeated re-use.

The body of the clip is of bronze or malleable iron, according to preference, and is provided with such size of threaded socket or



IMPROVED MECHANICAL TROLLEY CLIP.

stud required for attachment to any of the standard forms of insulation. The wedge or key is of bronze and the saddle of hard rolled sheet copper or Bessemer steel.

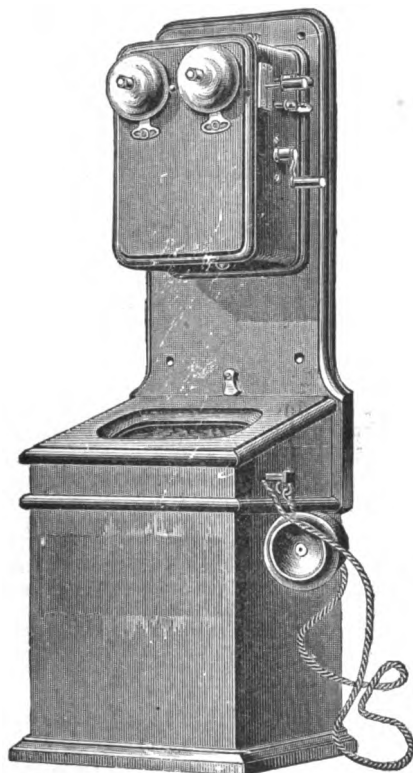
This company own and control a number of patents for improvements in overhead frogs, section insulators, etc., which are becoming very popular.

APPARATUS OF THE COLUMBIA TELEPHONE MANUFACTURING CO.

THE accompanying illustration represents the telephone transmitter now being placed upon the market by the Columbia Telephone Mfg. Co., of 138 Front street, New York. This company controls the patents of Messrs. Jas. W. McDonough, and H. H. Eldred—well-known pioneers in telephone work in this country—as well as those of other inventors.

The instrument illustrated is provided with a multiple contact carbon transmitter. This consists of a series of pencils resting in bearings and having their bearing points rose-shaped so as to afford a number of sharp contact points. The carbons are attached to the under side of a thin wooden diaphragm against which the speaker's voice is directed.

The receiver when not in use is suspended on a hook at the top of which a switch is placed. When the receiver is suspended on the hook a bell rings, and continues ringing until the switch is thrown over, thus cutting out the battery and preventing it from running down.



THE COLUMBIA TELEPHONE SET.

Besides the instruments described, the company will shortly bring out a simple and ingenious automatic telephone exchange system which permits of a subscriber putting himself in communication with any other subscriber without the intermediary of an operator at the exchange.

PROGRESS OF THE THOMSON ELECTRIC WELDING METHOD.

GENERAL MANAGER H. A. ROYCE says of the affairs of the Thomson Electric Welding Company: "There has been no time within the last two years when there was as much business in sight, and when the prospects of the future were more gratifying, in spite of the unfavorable condition of business in the country, than at present. The welding of rails into continuous lengths for street railway purposes is rapidly coming to the front, with gratifying results where the machines are at work. Several miles of track have been welded at St. Louis, and two machines are now in operation in Brooklyn, under a contract to weld 100 miles of track within a year; but independent of this work, which will bring a substantial revenue to our company, and the welding of projectiles which is exciting much attention abroad, and for which we hold the shell patents, there have been substantial developments in various directions throughout the country affecting almost every branch of metal industry.

"We have over 100 plants in operation, working satisfactorily to the parties who have leased them and saving them much money, and with greatly superior results over the old forge methods. Our machines at the present time take in a range from the smallest wire to sections of 25 square inch, the former requir-

ing automatic apparatus of delicate construction, and the latter ponderous machines weighing over 80 tons. Several parties have lately duplicated their apparatus, finding the process of such value to them as to demand the increase. One of the firms, who about four years since leased a machine from us at \$3,500, has since increased that plant, until their investment is at the present time over \$300,000 in welding apparatus. Our development has been more rapid in directions where the work could not be done in any other way, but, in addition to this, many machines have been leased which are in direct competition with the old methods, and are working most satisfactorily at the present time.

"The variety of uses to which electric welding has been put covers almost the entire range of metal working. Iron, steel or copper, axles and tires for carriage work, carriage irons of which one firm in the first three months of 1894 welded 270,000, fifth wheels, pipe of various sizes for refrigerating and other purposes, tires for bicycles and other small vehicles, agricultural implements, wire cable for tramway purposes, printers' chases, heavy wagon axles and tires, wire hoops for wooden packages, reamers, twist drills, heavy forgings for railway purposes, etc., etc."

THE LIVGRO INCANDESCENT LAMP.

ELSEWHERE in this issue we describe the Livgro incandescent lamp, which is claimed to be outside of the claims of the Edison patent and in which a special alloy forms the air seal of the lamp. The Livgro Incandescent Lamp Company have started to manufacture these lamps at Harrison, N. J., under the patents of Dr. W. E. Forest, and it is said that the price at which they can be produced will enable them to compete successfully with any lamp on the market. Mr. C. F. Whittemore, former secretary and treasurer of the Davis Electric Lamp Co., of Springfield, Mass., has full charge of the factory, which will be able to supply all orders in less than a month hence.

THE CLEVELAND, O., GENERAL ELECTRIC CO.

Spencer Trask & Co., has completed negotiations by which its friends will have the practical management of the Cleveland General Electric Company.

Spencer Trask & Co.'s negotiations for a substantial interest in the company provided that the banking house and its friends should have the management of the company and in return should furnish the money for the completion of the improvement and for the company's operation on an adequate scale. It was stipulated that local holdings should not be lessened, but rather increased, if any change were made in that respect, and that the banking house should purchase for those whom it represented \$500,000 of the company's unissued 6 per cent. bonds, an equal amount having previously been placed through the company's former alliances, and a good stock interest in the capital of \$1,000,000.

George Foster Peabody of the banking firm enters the Board of Directors, Samuel Scovil, long engaged with the firm in a confidential capacity, will be vice-president and treasurer, and Robert Lindsay, formerly assistant superintendent of the Brooklyn Edison Company, becomes manager. Plans for the improvement and enlarged operations will be carried out with the least possible delay.

THE NEW STANLEY CATALOGUE.

A FEW weeks ago we illustrated and described the new two-phase apparatus of the Stanley Electric Mfg. Co., of Pittsfield, designed and perfected by Messrs. Wm. Stanley, John F. Kelly and C. C. Chesney, who had already been associated in some very interesting single-phase work. The new two-phase motors, generators, etc., are now most admirably set forth in a new catalogue, one of the most artistic productions of the celebrated Bartlett press. The cover is superbly embossed, and the contents fill 60 pages of cuts and text printed in sepia and black inks. Our readers have been made familiar with the general details of the system, but should at once secure copies of this beautiful pamphlet, as it not only gives some supplementary information, but contains tables, etc., of great value.

WESTERN UNION FIGURES.

The approximate operations of the Western Union Telegraph Company for the fiscal year are given below:

Year June 30.....	1893-94.	1892-93.	Decrease.
Net.....	\$5,850,000	\$7,568,130	\$1,718,130
Int. and s. f.....	974,082	933,331	*40,751
Balance.....	\$4,875,918	\$6,634,799	\$1,758,881
Dividends.....	4,740,000	4,632,102	*107,898
Surplus.....	\$135,918	\$2,002,697	\$1,866,779
*Increase.			

NEW YORK NOTES.

MR. E. PAYSON TRUMBULL, formerly with the Deane Steam Pump Co., has accepted a position as representative in the sales department of the Henry R. Worthington Co.

MR. HENRY V. PARSELL has purchased a new and handsome electric launch from the General Electric Launch Co., and shipped the same to Schroon Lake for use there the coming summer. The launch is equipped with batteries of the Consolidated Electric Storage Co.

MR. GEORGE CUTTER has been east during the past week or two and has made arrangements for the general western agency of the Chicago Wire Co. of Wilmington, Del. He has also been given the agency for the States of Wisconsin, Michigan, Indiana and Illinois (exclusive of Chicago) for the Interior Telephone Co. of New York.

THE CROCKER-WHEELER ELECTRIC Co., associated with Beaman & Smith, of Providence, have brought out recently a boring mill electrically driven. It is a compact piece of mechanism, the motor being mounted in the rear of the column carrying the spindle head. The whole apparatus weighs 10 tons. It is 10 feet high and 18 feet long.

WESTERN NOTES.

MR. C. B. FAIRCHILD, Editor of the *Street Railway Journal*, New York, is making a short stay in Chicago.

FIVE hundred sticks was a recent single days' shipment of Allen soldering sticks by the Electric Appliance Co.

MR. H. P. BROUGHTON, of Jas. I. Ayer & Co., St. Louis, was in Chicago for several days last week, looking after some special work his firm is engaged in.

THE EMMONS ELECTRIC COMPANY has been organized at Chicago by Charles P. Emmons, Fred J. Tank and James Perry. The capital stock is \$50,000.

THE DIAMOND ELECTRIC COMPANY, Peoria, Ill., was incorporated on the 14th inst. with a capital stock of \$60,000, by John H. Francis, Wm. E. Francis and G. A. Shafer.

MR. D. N. MCBRIER, vice-president, Ball Engine Company, Erie, Pa., is spending a few days in Chicago. McBrier reports the business outlook to be a little more encouraging than last month.

THE MOMENCE ELECTRIC BALL STORAGE BATTERY COMPANY has been incorporated at Momence, Ill. with a capital stock of \$15,000 by Chas. A. Smyth, Lincoln Walker, and Frank E. Lane.

MR. W. H. COTHREN, well-known through his former connection with the Edison interests in Chicago, has been called to Cincinnati to accept a position under Mr. Jno. I. Beggs, now president of the Cincinnati Edison Co.

THE CONSUMERS ELECTRIC LIGHT COMPANY has asked the Chicago Council for a franchise to operate the territory bounded by the South line of the Chicago River, Western limits, Twenty-second street and the lake. The company is to erect a \$60,000 plant within a year.

THE ELECTRIC APPLIANCE COMPANY are exhibiting in their Chicago salesroom quite an elaborate line of Carpenter heating appliances which have attracted considerable attention notwithstanding the fact that the weather of the past week has been more in the direction of cooling appliances in the electric fan line. The Meston motor is bravely holding its own.

NORTHERN ELECTRIC RAILWAY, CHICAGO.—This company's ordinance which was introduced into the council on May 24, and which was referred to in THE ELECTRICAL ENGINEER at the time, has been recommended for passage by the council committee. The committee also recommended the passage of the ordinance of the Cicero and Proviso Railroad Company for a double track road on West 48th St. and West Chicago Ave.

STANDARD ELECTRIC Co., CHICAGO.—One of the latest and neatest productions of this company is their complete catalogue just issued. The book is a handsome volume of eighty-seven pages, 8 x 11 inches, containing a complete descriptive list of the company's products, each subject being illustrated by a photographic reproduction in half tone. Central station managers, superintendents and others interested will do well to send for a copy.

WALLACE ELECTRIC Co., Chicago, with the advent of summer weather, sultry days and cloudy nights, the central station manager prepares for thunder storms by increasing the number of lightning arresters on his circuits. The "W. W." Lightning arrester sold by the above company is claimed to possess points of merit not shared by other similar appliances and is being very favorably received by the trade. The Wallace Electric Co. also handle the "Wirt" commutator brush and report a steadily growing sale of this specialty.

THE WASHINGTON ELECTRIC Co., Chicago, report a gratifying increase of orders for their several specialties, such as the Meissner focussing lamps, Imperial rheostats, etc. They have recently made some improvements in their electric annunciators, making them much simpler, more durable and reliable.

THE D'UNGER LONG DISTANCE TELEPHONE COMPANY report business as exceptionally good in their line, considering the almost universal business depression. Franchises for subsidiary companies have been granted at Chicago, Bristol, Va., Rome, Ga., Anniston, Ala., Waukegan, Ill., Crookston, Minn., Biloxi, Miss., and Winchester, Ind. Exchanges are now being equipped at Jamestown, N. Y., Ocala, Fla., Trenton, Mo., Memphis, Tenn., Huntsville, Tex., Lynchburg, Va., Washington, Pa., Spokane, Wash., and several smaller places.

THE PERU ELECTRIC MFG. Co., of Peru, Ind., is circulating a neat and comprehensive catalogue of all its various goods, comprising its Laclede and Hercules batteries; Edison and Sawyer-Man styles of main and branch cut-outs together with a full line of rosettes, wall receptacles, key and keyless sockets of all systems, insulators, cleats, fuse blocks, etc. The company pride themselves greatly on their porcelain department, and they have the advantage of being located where they can burn their porcelain and carbons with natural gas. Their porcelain is burnt with natural gas at 4,000° Fah. producing a perfect body and glaze. The company have a nice factory, skilled force and a growing trade.

NEW ENGLAND NOTES.

THE HOLTZER-CABOT ELECTRIC Co., Boston, Mass., have just issued their Electrical Supply and Specialty Catalogue, copy of which may be obtained by application accompanied by business card.

THE STANLEY ELECTRIC Co., Pittsfield, Mass.—In order to keep up with the increasing demand for its apparatus this company is now erecting a new factory, 200 x 90 feet and three stories high. The foundations are already finished and the factory is expected to be in operation in a few months. The new works will be specially devoted to the manufacture of alternating single and two-phase dynamos and motors; the Stanley transformers will be built at the old works.

G. M. ANGLIER & Co., 116 Bedford St., Boston, Mass., who are exclusive contractors for apparatus manufactured by the Mather Electric Co., in New England, have just closed a contract with the Gardner Electric Street Railway Co., of Gardner, Mass., for one 160 h. p. Mather multipolar generator. Messrs. Angier & Co., are devoting a great deal of attention to the equipment of street railway plants, and, as the Mather generator in its present form has all the latest improvements and a very high efficiency, a good business during the present season is confidently expected.

PHILADELPHIA NOTES.

THE ACME TESTING SET made by Queen & Co., Philadelphia, is meeting with a continually increasing success. Its compactness and lightness are much greater than the sets previously designed by this firm, it being contained in a box 8" x 6" x 5" and weighing but six lbs. The quickness with which resistance measurements can be made with it, renders it popular with electric light and railway companies, dynamo and motor manufacturers, inspectors, etc. A specially valuable feature is the ability to use it anywhere even in the closest proximity to large dynamos.

STERN & SILVERMAN of Philadelphia report business as very active. In the railway department they have contracts for the reconstruction for the Brigantine Transit Company's road at Brigantine, N. J., seven miles in length on trestle construction; at Altoona, the Bellwood extension of the Logan Valley Road for the Pennsylvania R. R., eight miles in length; also the Roxborough Inclined Plane and Railway, six miles long, running from Philadelphia to Barren Hill. In the Steam Department they report a 600 H. P. boiler plant for the Roxborough road, and two 300 H. P. Ball and Wood compound condensing engines; one 10in. x 11in. direct connected Ball & Wood engine for Dooner's Hotel, Philadelphia; one 10in. x 11in. direct connected Ball & Wood engine for the Mann Building, Philadelphia; and one 8in. x 10in. engine for the boat "Havana." In the Lighting Department they have contracts under way for a central station at Overbrook, Pa.; the lighting of the Episcopal Hospital, Philadelphia; electrical equipment of the river boat "Havana;" and arc plant for the pleasure pavilions at Brigantine Beach, N. J.

Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE Electrical Engineer.

Vol. XVIII.

JULY 11, 1894.

No. 323.

PHYSICAL ANALYSIS OF THE CONDITIONS ON A CIRCUIT CONTAINING DISTRIBUTED CAPACITY AND SELF-INDUCTION WHEN SUBJECTED AT ONE POINT TO A SIMPLE HARMONIC E. M. F.

BY

Wm. A. Anthony.

FIG. 1 represents such a circuit, A is a generator producing a harmonic E. M. F. of a certain fixed period. Call F the forward brush and B the backward brush, direction from left to right through the generator being positive. We may consider that during the positive phase of the E. M. F. the generator is transferring electricity from the line in the rear to the line in front.

The effect at the beginning of the positive phase is to give to the line immediately in the rear of the generator a negative charge and to the line immediately in front a positive charge. Hence current flows toward the generator from the rear and from the generator in front. But the effect of this disturbance is not felt at once throughout the line, it is propagated as a *current wave* with a certain definite velocity, just as a sound wave is propagated through the air, or a water wave over the surface of water. The rate of propagation of the electric current wave depends upon the capacity, self-induction, resistance, and frequency, and may be computed when these are known. Current waves are then propagated from the generator, both forward and backward, with a determinate velocity. In both waves the direction of the current is positive or from left to right during the positive phase of the E. M. F. When the negative phase of E. M. F. begins, electricity is transferred from the front to the rear of the generator and current waves are propagated forward and backward, as before, except that the direction of the current in both waves is negative. During a complete cycle of the generator, the current wave will travel a certain distance, say, Ff Fig. 1.

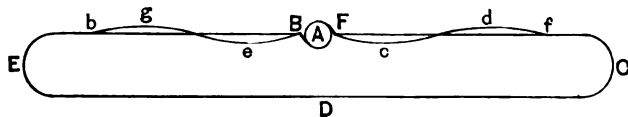


FIG. 1.

By cycle in this article will be understood a complete period beginning with the instant that the E. M. F. of the generator is passing through zero from negative to positive. With this understanding it is evident that the curve $Fcdf$ will represent at the end of a cycle the current at different points along that part of the line that has been traversed by the forward wave during cycle. In the same way $Beqb$ represents the current in that part of the line traversed by

the backward wave. The distance Ff or Bb is a *wave length*.

In order to follow all the effects of these waves let us consider the form of the energy after being delivered to the line by the generator. A part of the energy is consumed in overcoming the resistance of the line and is lost as heat. Another part, and it may be much the greater part, is stored

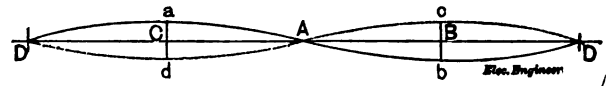


FIG. 2.

in the line as kinetic energy due to the self-induction, or as potential energy due to the electric charge, or both. If the line be left to itself after the first waves are started, this stored energy will cause the waves, in which the current is alternately positive and negative, to continue round and round the circuit until the energy is consumed in the resistance of the line.

If the generator continues in operation and the wave on reaching it finds an E. M. F. opposed to the current, then the current impelled by the E. M. F. of self-induction or electric stress upon the line against this opposing E. M. F. does work upon the generator, or in other words the energy stored in the line is returned to the generator and there is lost to it only the amount of energy represented by C^2R . It is evident, also, that unless the length of the circuit is some exact multiple of the length of a wave, the wave will, as it travels round and round the circuit, finally meet at the generator an opposing E. M. F., when what is left of the energy originally stored in that wave will be returned.

But the most interesting case to be considered is one in which the length of the circuit is an exact multiple of a wave length. Then, no matter how many times a wave may traverse the circuit, it will always find the generator, when it reaches it, in the same phase as when it started. Instead of giving up its energy to the generator, it receives from the generator an added impulse and the intensity of the current will be increased with each returning wave until it becomes so great that the C^2R loss is equal to the entire power of the generator.

For convenience in studying the changes that take place on the circuit, let this be represented by the straight line DAD , Fig. 2; A being the position of the generator, and D representing one point,—the middle point of the circuit most distant from the generator. That is, the two ends D are supposed to be joined together, and ABD, DCA , are the outgoing and returning lines. Assume the length of the circuit to be one wave length, and consider the condition along the line at the end of the first cycle. The front of the forward wave of current which started from the generator at the beginning of the cycle will have just reached the generator from the left, having traversed the complete circuit. The ordinates of the full line curve $AadbA$ will represent the strength and direction of the current at different points on the line at the instant assumed, due to

the forward wave. In the same way $a c d d a$ will represent the current due to the backward wave.

This will be evident from the consideration that in both waves the current at the start is positive. At the end of the first cycle the front of the forward wave will have just reached A from the left and the front of the backward wave will have just reached A from the right. $a d$ represents, therefore, the positive half of the forward wave and $d b a$ its negative half. So $a c d$ represents the positive half of the backward wave and $d d a$ the negative half. We may suppose each of these waves to continue traveling round and round the circuit, the currents represented by them becoming less and less intense until they become inappreciable. At each return to A a new wave starts and travels on with the original one, and, after a sufficient number of complete cycles, we shall have upon the circuit a number of waves represented by curves in every way similar to those of Fig. 2 with their crests all on the same lines $a d, c b$, but with ordinates becoming less and less until, in the oldest waves, they are inappreciable. The actual current on the line due to the forward waves would then be represented by a curve whose ordinate at any point would be the sum of the ordinates at that point of all the smaller curves. In the same way, a single curve obtained by summing the ordinates of the backward curves, would represent the current due to the backward waves. These summation curves would be similar in all respects to the curves of Fig. 2 except in the length of the ordinates.

To illustrate: Suppose the generator to have an E. M. F. of 100 volts and the resistance of the line to be one ohm.

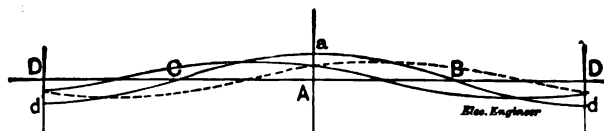


FIG. 3.

Suppose the self induction to be such that the generator is able to produce during the first cycle a current equivalent to only one ampere. The loss on the line is only 1 volt and there should remain stored in the circuit $\frac{1}{100}$ ths of the energy imparted so that for the second time round the curve will only be slightly lower than for the first, and, since the decay is logarithmic, it will only be after some hundreds of cycles that it will become inappreciable. The summation of all these curves will be represented by a curve whose ordinates are many times as great as the ordinates of the curve representing the whole current at the end of the first cycle. In other words, on the supposition that the length of the line is exactly a wave length, so that the successive waves traveling round the circuit in one direction are all in the same phase, the current goes on increasing with cycle after cycle until it reaches the value $\frac{E}{R}$.

Assuming a suitable vertical scale for the drawing, Fig. 2 may be taken to represent the summation curves at the instant that a new cycle is beginning, that is, when the E. M. F. of the generator is zero and passing from negative to positive. The real current on the line is, of course, represented by the sum of the ordinates of these two curves, and at this particular instant it is zero throughout the whole length of the line. To find the current at any other instant we have only to consider the two curves to advance, the one towards the right and the other towards the left, and again sum up the ordinates.

In Fig. 3 about an eighth of a period is supposed to have elapsed and the two curves have advanced about one-eighth of a wave length. At c and b the ordinates are of opposite sign and equal, showing that there is no current

at those points. At A both ordinates are positive and at D both are negative. A very little consideration will show that whatever the amount of advance of the two curves, their ordinates will always be equal and opposite at c and b , and that the sum will be of one sign along $c A b$ and of the opposite sign along $c D b$. The real wave of current

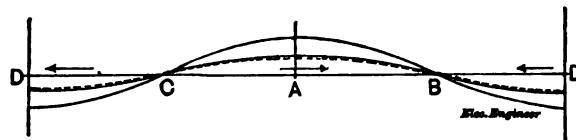


FIG. 4.

on the circuit is, therefore, a stationary wave having nodes of no current at c and b and antinodes of maximum current at A and D . It will be remembered that the condition shown in Fig. 2 occurs at the moment when the positive E. M. F. is just on the point of beginning at the generator. A quarter period later the wave $a b$ will have moved to the right one-fourth of a wave length, $c d$ will have moved to the left one-fourth of a wave length. The two waves will coincide, passing through the points c and b , and the resultant wave will be represented by a curve whose ordinate at A is double the maximum ordinate of the component curves, as shown in Fig. 4, where in order to represent the dotted curve it is shown inside the other.

It is important to note that at this instant, a quarter period later than the epoch Fig. 2 represents, the impressed E. M. F. furnished by the generator is a maximum and positive, and that the current at A , as shown by Fig. 4, is a maximum and positive also. It is easy to show that at every instant the current at A , and in fact anywhere along $c A b$, coincides in phase with the impressed E. M. F.

By a method entirely similar, the potential curves may be deduced. As explained for the current waves for the first cycle, forward and backward potential waves start from the forward and rear brushes, but the potential wave starting from the rear brush is negative instead of positive; and it is, therefore, a negative wave whose front arrives at A from the right at the end of the cycle, and the dotted curve in Fig. 5 represents the complete backward wave at that instant. The full line curve represents the corresponding forward wave. Just as in the case of the current waves, these potential waves travel round and round the circuit gradually dying away. In the example previously given, the fall of potential at the end of the first journey around the circuit would be only about one volt, and the potential due to this first wave would become inappreciable only after some hundreds of cycles. But at that time the potential due to the forward and backward waves, respectively, would be the resultant of some hundreds of waves, all in the same phase, and since the latest of these would represent a potential difference of about 100 volts, while the next to the last would represent some 99 volts, it is evident that the resultant curves would represent potentials of several thousand volts. If the full and dotted lines of Fig. 5 are taken to represent, respectively, the resultant

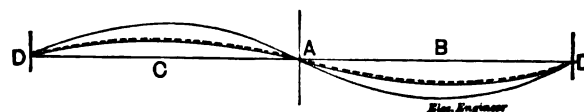


FIG. 5

forward and backward waves, the heavy line will represent the final resultant. Assuming the full line curve to move to the right and the dotted curve to the left it is plain that the ordinates will always be equal and opposite at A and D . Therefore the resultant wave is a stationary wave having nodes at A and D and ordinates all of one sign on one side of A and of the opposite sign on the

other side. It is seen, too, that the nodes of the potential wave at A and D correspond to the antinodes of the current wave, and the antinodes of the potential wave at B and C correspond to the nodes of the current wave. It is plain, too, that the difference of potential between B and C, one of which is always positive when the other is negative, may be many times—hundreds or even thousands of times—the E. M. F. of the generator.

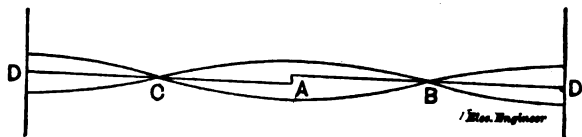


FIG. 6.

Another consideration will show that this must be so. Referring to Fig. 4, current is flowing toward B from both sides, and away from C at both sides. In the illustration assumed this current has reached, by accumulation through some hundreds of cycles, a value of 100 amperes through a self-induction in which an impressed E. M. F. of 100 volts can only produce a current of 1 ampere, and yet this current of 100 amperes through that self-induction must be stopped and reversed during every cycle. This can only be accomplished by an electric pressure of thousands of volts. This pressure is obtained by the accumulation of a positive charge in A B D and a negative charge in A C D which reach a maximum value a quarter period later than the epoch represented in Fig. 4, and it is plain that the capacity of A B D must be just such that the charge which accumulates during the quarter period shall produce a pressure just sufficient to balance the E. M. F. of self-induction acting along A B.

It is now clear how capacity neutralizes self-induction, and why a given capacity should neutralize self-induction for one period and not for another. Self-induction is neutralized because the line is so tuned as to permit the accumulation of the periodic impulses of the generator, and whenever a large periodic current is maintained through a large self-induction, by means of a small E. M. F. it is because there has been developed somewhere in the circuit an alternating electric stress or pressure of sufficient magnitude to balance the E. M. F. of self-induction due to such a current.

Supposing a quarter period to have elapsed since the epoch represented in Fig. 5, we have the condition as to potential represented in Fig. 6. This is the instant of zero potential due to the potential waves. As is evident from the figure the resultant of these waves is the straight line D A D. But at this instant the E. M. F. of the generator is positive and a maximum and causes a rise of potential between the rear and forward brushes. Hence, the actual potential on the circuit at this epoch is represented by some such line as D C A B D broken at A by a sudden rise of pressure.

In this discussion I have taken no account of any self-induction or capacity there might be in the generator. It is possible that these might have such a relation to the self-induction and capacity of the line as to materially alter the position of the nodal points and might even bring the antinodes B and C of the potential wave within the generator. This, no doubt, is what happened with the Deptford plant.

On the supposition that the self-induction and capacity are distributed uniformly upon the line the circuit might be cut at B and C and the ends left insulated. The part B A C is then equivalent to a line containing self-induction and a condenser in series. Waves would be reflected from the insulated ends B and C, and current would flow and potentials vary on B A C precisely as when it formed a part of the closed circuit A B D C. In fact B A C, when insulated from the rest of the circuit, is the equivalent of Dr. Pupin's resonant circuit illustrated on page 489, June

6 issue of THE ELECTRICAL ENGINEER, except that in our case the capacity is distributed while in Dr. Pupin's circuit it is all at the ends of the line; and just as Dr. Pupin with an E. M. F. of 150 volts at his transformers, obtains 2,500 volts at his condenser, so there would be between B and C, potential differences many times greater than the E. M. F. of the generator.

I have not given the above as a rigid investigation of what takes place on a circuit having distributed capacity and self-induction—but while it does not give accurate quantitative results, it does give by a method easily followed by readers unfamiliar with the higher calculus, an explanation of the phenomena observed on resonant circuits, and, at least, the order of magnitude of the effects on different parts.

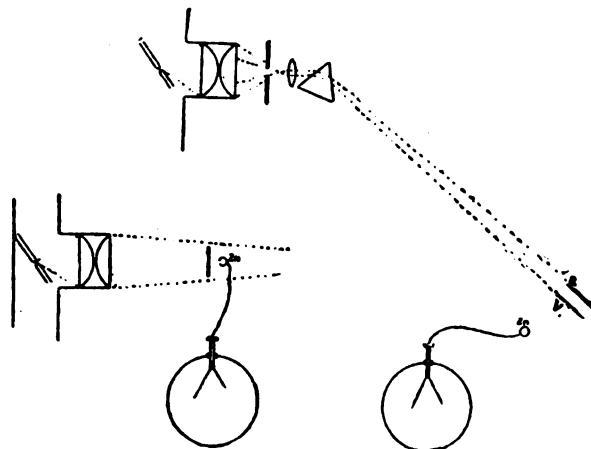
THE WORK OF HERTZ.—II.

BY DR. OLIVER J. LODGE, F.R.S.

Zinc Discharging Negative — Electricity in Light; Gold Leaf Electroscope; Glass and Quartz Panes; Quartz Prism.

Take a piece of zinc, clean it with emery paper, connect it to a gold leaf electroscope, and expose it to an arc lamp. If charged positively nothing appears to happen, the action is very slow; but a negative charge leaks away in a few seconds if the light is bright. Any source of light rich in ultra-violet rays will do; the light from a spark is perhaps most powerful of all. A pane of glass cuts off all the action; so does atmospheric air in sufficient thickness (at any rate, town air), hence sunlight is not powerful. A pane of quartz transmits the action almost undiminished, but fluor-spar may be more transparent still. Condensing the arc rays with a quartz lens and analyzing them with a quartz prism or reflection grating, we find that the most effective part of the light is high up in the ultra violet, surprisingly far beyond the limits of the visible spectrum¹ (Figs. 7 and 8).

This is rather a digression, but I have taken some pains to show it properly because of the interest betrayed by Lord Kelvin on this

FIG. 7.
Zinc Rod with Glass Screen.FIG. 8.
Zinc Rod with Ultra-violet Light.

matter, and the caution which he felt about accepting the results of the Continental experimenters too hastily.

It is probably a chemical phenomenon, and I am disposed to

1. While preparing for the lecture it occurred to me to try, if possible, during the lecture itself, some new experiments on the effect of light on negatively charged bits of rock and ice, because if the effect is not limited to metals it must be important in connection with atmospheric electricity. When Mr. Branly coated an aluminum plate with an insulating varnish, he found that its charge was able to soak in and out of the varnish during illumination (*Comptes Rendus*, Vol. CX., p. 993, 1890). Now, the mountain tops of a negatively charged earth are exposed to very ultra-violet rays, and the air is a dielectric in which quiet up-carrying and sudden downpour of electricity could go on in a manner not very unlike the well-known behavior of water vapor; and this perhaps may be the reason, or one of the reasons, why it is not unusual to experience a thunderstorm after a few fine days. I have now tried these experiments on such geological fragments as were handy, and find that many of them discharge negative electricity under the action of a naked arc, especially from the side of the specimens which were somewhat dusty, but that when wet they discharge much less rapidly, and when positively charged hardly at all. Ice and garden soil discharge negative electrification, too, under ultra-violet illumination, but not so quickly as limestone, mica schist, ferruginous quartz, clay, and some other specimens. Granite barely acts; it seems to insulate too well. The ice and soil were tried in their usual moist condition, but, when thoroughly dry, soil discharges quite rapidly. No rock tested was found to discharge as quickly as does a surface of perfectly bright metal, such as iron, but many discharged much more quickly than ordinary dull iron, and rather more quickly than when the bright iron surface was thinly oiled or wetted with water. To-day (June 5) I find that the leaves of the geranium discharge positive electrification five times as quickly as negative, under the action of an arc light, and that glass cuts the effect off while quartz transmits it.

express it as a modification of the Volta contact effect² with illumination.

Return now to the Hertz vibrator, or Leyden jar with its coatings well separated, so that we can get into its electric as well as its magnetic field. Here is a great one giving waves 80 metres long, radiating while it lasts with an activity of 100 H. P., and making ten million complete electric vibrations per second.

Large Hertz Vibrator in Action; Abel's Fuse; Vacuum Tube; Strike an Arc.

Its great radiating power damps it down very rapidly, so that it does not make above two or three swings; but nevertheless, each time it is excited, sparks can be drawn from most of the reasonably elongated conductors in this theatre.

A suitably situated gas-leak can be ignited by these induced sparks. An Abel's fuse connecting the water pipes with the gas pipes will blow off; vacuum tubes connected to nothing will glow (this fact has been familiar to all who have worked with Hertz waves since 1889); electric leads, if anywhere near each other, as they are in some incandescent lamp-holders, may spark across to each other, thus striking an arc and blowing their fuses.

This blowing of fuses by electric radiation frequently happened at Liverpool till the suspensions of the theatre lamps were altered.

The striking of an arc by the little reverberating sparks between two carbon points connected with the 100 volt mains I incidentally now demonstrate.

There are some who think that lightning flashes can do none of these secondary things. They are mistaken.

On the table are specimens of various emitters and receivers such as have been used by different people (see Table). The orthodox Hertz radiator of dumb-bell type (Fig. 9), the orthodox Hertz

making a feeble disturbance very visible. Explosives may be used for the same purpose, either in the form of mixed water-gases or in the form of an Abel's fuse. Fitzgerald found that a tremendously sensitive galvanometer could indicate that a feeble spark had passed, by reason of the consequent disturbance of electrical equilibrium which settled down again through the galvanometer.⁵ This was the method he used in this theatre four years ago. Blyth used a one-sided electrometer, and young Bjerknes has greatly developed this method (Fig. 14), abolishing the need for a spark,

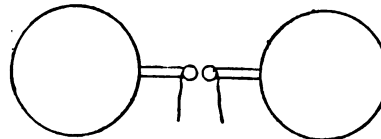


FIG. 10.
Standard Hertz Radiator.

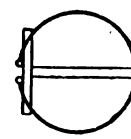


FIG. 11.
Circular Resonator.

and making the electrometer metrical, integrating, and satisfactory.⁶ With this detector many measurements have been made at Bonn by Bjerknes, Yule, Barton, and others on waves concentrated and kept from space dissipation by guiding wires.

Mr. Boys has experimented on the mechanical force exerted by electrical surging, and Hertz also made observations of the same kind.

Going back to older methods of detecting electrical radiation, we have most important of all, a discovery made long before man existed, by a creature that developed a sensitive cavity on its skin;

Detectors of Radiation.

PSYCHOLOGICAL.	CHEMICAL.	THERMAL.	ELECTRICAL.	MECHANICAL.	MICROPHONIC.
Eye. × Frog's Leg. (Hertz and Ritter.)	Photographic Plate. Explosive Gases. Photoelectric Cell.	Thermopile. Bolometer. (Rubens and Ritter.) Expanding Wire. (Gregory.) Thermal Junction. (Klemencic.)	Spark. (Hertz.) Telephone: Air-gap and Arc. (Lodge.) Vacuum Tube. (Dragoumis.) Galvanometer. (Fitzgerald.) Air-gap and Electroscopic. (Boltzmann.) Trigger Tube. (Warburg and Zehnder.)	Electrometer. (Blyth and Bjerknes.) Suspended Wires. (Hertz and Boys.)	Selenium (?) Impulsion Cell. (Minchin.) Filing. (Branley.) Cobber. (Hughes and Lodge.)

× The cross against the frog's leg indicates that it does not appear really to respond to radiation, unless stimulated in some secondary manner. The names against the other things are unimportant, but suggest the persons who applied the detector to electric radiation. The interrogation mark against Selenium indicates that its position in the microphonic column may be doubtful.

receivers (Fig. 10); a circular ring (Fig. 11) for interference experiments, because it is but little damped, and a straight wire for receiving at a distance, because it is a much better absorber. Beside these are the spheres and ellipsoids (or elliptical plates), which I have mainly used, because they are powerful radiators and absorbers, and because their theory has been worked out by Horace Lamb and J. J. Thomson. Also dumb-bells without air-gap, and many other shapes, the most recent of mine being the inside of a hollow cylinder with sparks at ends of a diameter; this (Fig. 12) being a feeble radiator, but a very persistent vibrator,³ and therefore, well adapted for interference and diffraction experiments. But, indeed, spheres can be made to vibrate longer than

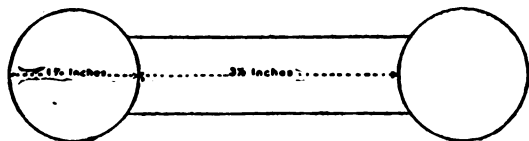


FIG. 9.
A Dumb-bell Form of Radiator.

usual by putting them into copper hats or enclosures, in which an aperture of varying size can be made to let the waves out.

Many of these senders will do for receivers too, giving off sparks to other insulated bodies or to earth; but, besides the Hertz type of receiver, many other detectors of radiation have been employed. Vacuum tubes can be used, either directly or on the trigger principle, as by Zehnder (Fig. 13),⁴ the resonator spark precipitating a discharge from some auxiliary battery or source of energy, and so

a creature which never so much as had a name to be remembered by (though, perhaps, we now call it trilobite). Then, in recent times, we recall the photographic plate and the thermopile with its modification, the radiomicrometer; also the so-called bolometer, or otherwise known Siemens' pyrometer, applied to astronomy by Langley; applied to the detection of electric waves in wires by Rubens and Ritter and Paalzow and Arons. The thermal junction was applied to the same purpose by Kolacec, D. E. Jones, and others.

And, before all these, the late Mr. Gregory, of Cooper's Hill,

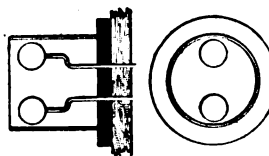


FIG. 12.
Dr. Lodge's Hollow Cylindrical Resonator, arranged horizontally against the inside of a Wooden Box.

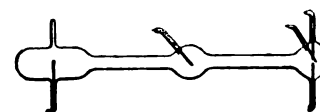


FIG. 13.
Zehnder's Trigger Tube.

made his singularly sensitive expansion meter, whereby waves in free space could be detected by the minute rise of temperature they caused in a platinum wire, a kind of early and sensitive form of Cardew voltmeter.

Going back to the physiological method of detecting surging, Hertz tried the frog's-leg nerve and muscle preparation, which to the steadier types of electrical stimulus is so surpassingly sensitive, and to which we owe the discovery of current electricity. But he failed to get any result. Ritter has succeeded; but, in my

² See Brit. Assoc. Report, 1884, pages 502-519, or *Phil. Mag.*, Vol. XIX, pages 267-252.

³ J. J. Thomson "Recent Researches," 344. ⁴ *Wied. Ann.*, XLVII, 47, p. 17.

⁵ Fitzgerald, *Nature*, Vol. XLI., p. 296, and Vol. XLII., p. 172.

⁶ *Wied. Ann.*, XLIV., 44, p. 74.

experience, failing in the normal and proper result. Working with my colleague Prof. Gotch, at Liverpool, I, too, have tried the nerve and muscle preparation of the frog (Fig. 15), and we find that an excessively violent stimulus of a rapidly alternating character, if pure and unaccompanied by secondary actions, produces no effect—no stimulating effect, that is—even though the voltage is so high that sparks are ready to jump between the needles in direct contact with the nerve.

All that such oscillations do, if continued, is to produce a temporary paralysis or fatigue of the nerve, so that it is unable to transmit the nerve impulses evoked by other stimuli, from which paralysis it recovers readily enough in course of time.

This has been expected from experiments on human beings, such experiments as Tesla's and those of d'Arsonval. But an entire animal is not at all a satisfactory instrument wherewith to attack the question; its nerves are so embedded in conducting tissues that it may easily be doubted whether the alternating type of stimulus ever reaches them at all. By dissecting out a nerve and muscle from a deceased frog after the historic manner of physiologists, and applying the stimulus direct to the nerve, at the same time as some other well known $\frac{1}{10}$ th of a volt stimulus is applied to another part of the same nerve further from the muscle, it can be shown that rapid electric alternations, if entirely unaccompanied by static charge or by resultant algebraic electric transmission, evoke no excitatory response until they are so violent as to give rise to secondary effects such as heat or mechanical shock. Yet, notwithstanding this inaction, they gradually and slowly exert a paralyzing or obstructive action on the portion of the nerve to which they are applied, so that the nerve impulse excited by the feeble but perceptible $\frac{1}{10}$ th-volt stimulus above is gradually throttled on its way down to the muscle, and remains so throttled for a time varying from a few minutes to an hour after the cessation of the violence.

I had intended to exhibit this effect, which is very marked and definite, but it is impossible to show everything in the time at my disposal.

Air Gap and Electroscope charged by Glass Rod and discharged by moderately distant Sphere excited by Coil.

Among trigger methods of detecting electric radiation I have spoken of the Zehnder vacuum tubes; another method is one used by Boltzmann. A pile of several hundred volts is on the verge of charging an electroscope through an air gap just too wide to break down. Very slight electric surges precipitate the discharge across the gap, and the leaves diverge. I show this in a modified and simple form. On the cap of an electroscope is placed a highly-polished knob or rounded end connected to the sole, and just not touching the cap (Fig. 16). Such an electroscope overflows suddenly and completely with any gentle rise of potential. Bring excited glass near it, the leaves diverge gradually and then suddenly collapse, because the air space snaps; remove the glass, and they rediverge with negative electricity; the knob above the cap being then charged positively, and to the verge of sparking. In this condition any electrical waves, collected if weak by a foot or so of wire projecting from the cap, will discharge the electroscope by exciting surges in the wire, and so breaking down the air-gap. The chief interest about this experiment seems to me the extremely definite dielectric strength of so infinitesimal an air space. Moreover, it is

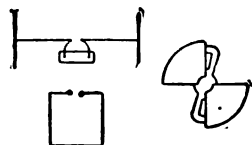


FIG. 14.

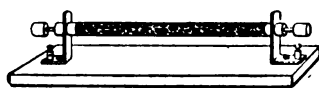
FIG. 18.
Iron Borings Coherer.

FIG. 15.

Experiment of Gotch and Lodge on the physiological effect of rapid pure electric alternations. Nerve and muscle preparation, with four needles, or else non-polarizable electrodes applied to the nerve. C and D are the terminals of a rapidly alternating electric current from a conductor at zero potential, while A and B are the terminals of an ordinary very weak galvanic or induction coil stimulus only just sufficient to make the muscle twitch.

a detector for Hertz waves that might have been used last century; it might have been used by Benjamin Franklin.

For to excite them no coil or anything complicated is necessary; it is sufficient to flick a metal sphere or cylinder with a silk handkerchief and then discharge it with a well-polished knob. If it is not well polished the discharge is comparatively gradual, and the vibrations are weak; the more polished are the sides of an air-gap, the more sudden is the collapse and the more vigorous the consequent radiation, especially the radiation of high frequency, the higher harmonics of the disturbance.

For delicate experiments it is sometimes well to repolish the knobs every hour or so. For metrical experiments it is often better to let the knobs get into a less efficient but more permanent

state. This is true of all senders or radiators. For the generation of the, so to speak, "infra-red" Hertz waves any knobs will do, but to generate the "ultra-violet" high polish is essential.

Microphonic Detectors.

Receivers or detectors, which for the present I temporarily call microphonic, are liable to respond best to the more rapid vibrations. Their sensitiveness is to me surprising, though of course it does not approach the sensitiveness of the eye; at the same time, I am by no means sure that the eye differs from them in kind. It is these detectors that I wish specially to bring to your notice.

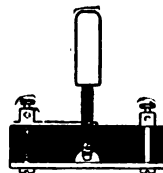


FIG. 16.

Air Gap for Electroscope.



FIG. 17.

Wire Coherer, consisting of a spiral of thin iron wire mounted on an adjustable spindle and an aluminum plate. When the lever is moved clockwise, against a stop not shown in the illustration, the tip of the iron wire presses very gently against the aluminum plate.

Prof. Minchin, whose long and patient work in connection with photo-electricity is now becoming known, and who has devised an instrument more sensitive to radiation than even Boys' radiomicrometer, in that it responds to the radiation of a star while the radiomicrometer does not, found some years ago that some of his slight excitable cells lost their sensitiveness capriciously on tapping, and later he found that they frequently regained it again while Mr. Gregory's Hertz-wave experiments were going on in the same room.

These "impulsion-cells," as he terms them, are troublesome things for ordinary persons to make and work with—at least I have never presumed to try—but in Mr. Minchin's hands they are surprisingly sensitive to electric waves.⁸

The sensitiveness of selenium to light is known to everyone, and Mr. Shelford Bidwell has made experiments on the variations of conductivity exhibited by a mixture of sulphur and carbon.

Nearly four years ago Mr. Edouard Branly found that a burnished coat of porphyzied copper spread on glass diminished its resistance enormously, from some millions to some hundreds of ohms when it was exposed to the neighborhood, even the distant neighborhood, of Leyden jars or coil sparks. He likewise found that a tube of metallic filings behaved similarly, but that this recovered its original resistance on shaking. Mr. Croft exhibited this fact recently at the Physical Society. Branly also made pastes and solid rods of filings in Canada balsam and in sulphur and found them likewise sensitive.⁹

With me the matter arose somewhat differently, as an outcome of the air-gap detector employed with an electroscope by Boltzmann. For I had observed in 1889 that two knobs sufficiently close together, far too close to stand any voltage such as an electroscope can show, could, when a spark passed between them, actually cohere; conducting an ordinary bell-ringing current if a single voltaic cell was in circuit; and, if there were no such cell, exhibiting an electromotive force of their own sufficient to disturb a low resistance galvanometer vigorously, and sometimes requiring a faintly perceptible amount of force to detach them. The experiment was described to the Institution of Electrical Engineers,¹⁰ and Prof. Hughes said he had observed the same thing.

Coherer in Open, Responding to Feeble Stimuli; Small Sphere Gas-lighter; Distant Sphere Electrophorus.

Well, this arrangement, which I call a coherer, is the most astonishing sensitive detector of Hertz waves. It differs from the actual air-gap in that the insulating film is not really insulating; the film breaks down not only much more easily, but also in a less discontinuous and more permanent manner than an air-gap. A tube of filings, being a series of bad contacts, clearly works on the same plan; and though a tube of filings is by no means so sensitive, yet it is in many respects easier to work with, and, except for very feeble stimuli, is more metrical. If the filings used are coarse, say turnings or borings, the tube approximates to a single coherer; if they are fine, it has a larger range of sensibility. In every case what these receivers feel are sudden jerks of current; smooth sinuous vibrations are ineffective. They seem to me to respond best to waves a few inches long, but doubtless that is determined chiefly by the dimensions of some conductor with which they happen to be associated. (Figs. 17 and 18.)

8. *Phil. Mag.*, Vol. XXXI., p. 223.

9. E. Branly, *Comptes Rendus*, Vol. OXL, p. 735; and Vol. CXII., p. 90.

10. *Journal Institution of Electrical Engineers*, 1890, Vol. XIX., pages 359-4; or "Lightning Conductors and Lightning Guards" (Whittaker), pages 333-4.

EXPERIMENTS ON TWO-PHASE MOTORS.¹

BY DR. LOUIS DUNCAN, S. H. BROWN, W. P. ANDERSON AND S. Q. HAYES.

The experiments, of which this article is a description, were intended for the purpose of developing a method of obtaining the current and electromotive force curves of multiphase motors, and of applying it to a two-phase, 2 H. P. Tesla motor kindly furnished

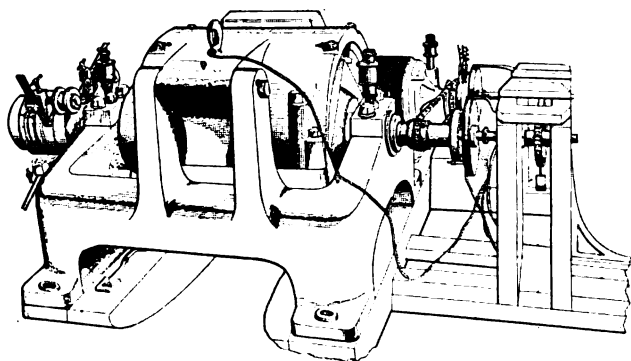


FIG. 1.

by the Westinghouse Electric and Manufacturing Company. While the results are probably correct for the machine tested, yet as the motor was small with inward projecting pole pieces, the results will differ considerably from those that would have been obtained on a larger machine, or one without projecting pole pieces. In a rotary field motor, if the resultant field is not exactly uniform, but presents some irregularities, the armature electromotive force will not in general be a periodic curve if the difference between the speed of the field and the speed of the armature is not a multiple of both; because if we consider an armature coil enclosing a maximum number of lines of induction, then when it again includes the maximum number, the field will be in a different position with respect to the poles, and its maximum value may be different. Or, to put it another way, if the difference of the speeds of the field and armature is not a multiple of both, any particular armature coil will not have the same relative position with respect to both the field and the pole pieces in its successive positions of maximum induction. It is necessary then, in order to obtain periodic armature currents, that some form of gearing be employed.

The apparatus experimented on, Fig. 1, consisted of a 25 H. P. two-phase dynamo—an ordinary constant current machine supplied with four collecting rings—and one two-phase, 8-pole, 2 H. P. Tesla motor. The electromotive force of the dynamo, as may be seen from the curves, was practically a sine curve. In our work the motor was not run up to its full capacity, as we were limited by the amount of power the gearing would safely transmit. The

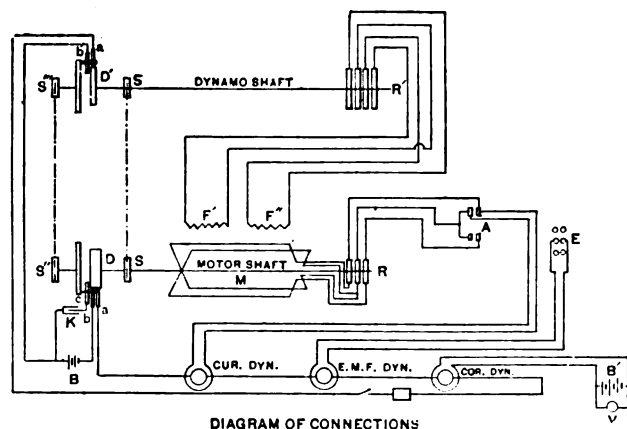


DIAGRAM OF CONNECTIONS

FIG. 2.

armature of this motor has, however, 41 slots. The odd slot was placed in the motor so that the relation of the armature teeth to the field poles should be different in different parts of the circumference, and the forty incipient dead points which might have occurred were avoided by the addition of the extra slot. The winding consists of four layers; the first and third are exactly

similar and coincident in the slots occupied, and the second and fourth are similarly related. The four coils in each layer are connected in series and short circuited. The idea was to make the mutual induction of an armature coil with respect to the poles a sine curve. Of course, with a limited number of slots, it is impossible to have the mutual induction of the field and armature exactly a sine curve. But it is possible to very nearly accomplish this, especially in large armatures, and the importance of it is beginning to be appreciated. Mr. Charles F. Scott, of the Westinghouse Company, was one of the first to appreciate the importance of the armature winding and the proper method of doing it, and he deserves much credit for his quiet and persistent work, which has resulted in the production of excellent motors instead of voluminous papers.

It is of course true, that the period of the armature current is the sum of the periods of the field and the armature. As we wished to obtain the curve of the armature current by the contact method, it became necessary to get contacts whose period was the sum of the field and armature periods. This was obtained by an arrangement of apparatus shown in Fig. 2. In the figure, *s* and *s'* are the two sprocket wheels which gear the two machines together and give them the desired relative speeds. *s''* and *s'''* are two others which gear the graduated discs which carry the brushes. *D* and *D'* are the two instantaneous contact discs, one mounted on each shaft, and *a*, *b*, *c*, *a'*, *b'*, are the wiping brushes. *K* is a condenser and *B* a charging battery. *b* and *c* make the circuit through the battery and condenser once every revolution, thus keeping the condenser charged. When *a* and *a'* make simultaneous contact, the battery circuit is broken and the condenser is discharged through the movable coils of the dynamometer which are all connected in series. *F* and *F'* are the motor field coils. *R*

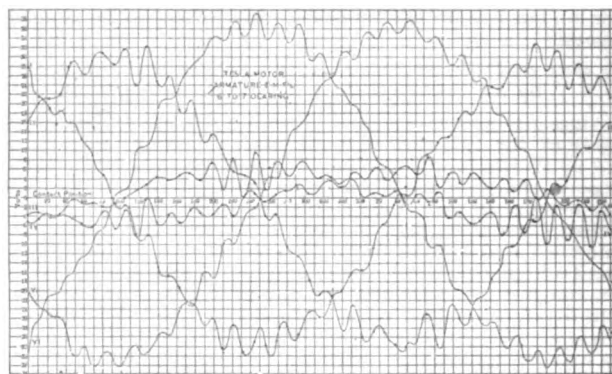


FIG. 3.

and *R'* the rings of the motor and dynamo respectively. *M* is a double pole, double throw switch to which are connected the terminals whose potential difference curves are desired. *M* is the motor armature, and *A* is a switch in the circuit of the current instrument. *B'* is a battery which sends a steady current through the large coils of a dynamometer. This dynamometer is used as a correcting instrument, and the resistance in the condenser circuit is regulated to keep its deflection constant. If the brushes are set together on the contacts, and then the two machines revolve with a given speed ratio, say, 4 to 3, the brushes will again be simultaneously on the contacts, when the machines have made, respectively, 4 and 3 revolutions. If the ratio were 7 to 6, the machines would make 7 and 6 revolutions before the contacts would again be coincident. In this way we obtained the needed instantaneous current.

After obtaining one point on the curve in this way, and wishing to obtain another point, we must shift our brushes through angular distances proportional to the speed ratio of the two machines; otherwise they would not make simultaneous contact again. Having shifted them in this ratio (that is, if the ratio is 6 to 7, we would shift 10 degrees on the dynamo discs, and $\frac{1}{6}$ of 10 degrees on the motor disc), we obtain another point on the curve. To accomplish this easily, we gear the brushes together in the same ratio as the armatures are geared, as is shown in Fig. 1. Our gearing both for the brushes and armatures consisted of sprocket wheels and chains and was very satisfactory.

The curves we have obtained are as follows: The electromotive force applied to the armature. Effective electromotive force of the armature. The counter electromotive force of the armature. The armature current. The value of field electromotive force and current for open and closed armature circuit. These for ratios of 3 to 4 and 6 to 7. We also obtained the various currents and electromotive forces when the armature was held stationary, with and without resistance, in the outside circuit. There are really three distinct sets of curves; those relating to the 3 to 4 gear-

1. Abstract of a paper presented at the 11th General Meeting of the American Institute of Electrical Engineers, Philadelphia, May 18, 1891.

ing, those for the 6 to 7 gearing, and those in which the armature was stationary. The angular positions do not correspond for the first two sets. For the second and third they very nearly correspond. In Figs. 3 and 4 the contact positions should be multiplied by 2. The length of an armature curve in terms of the positions of the dynamo brush should be $360 \times \frac{1}{4} = 720$ in the case of the 3 to 4 gearing, and $360 \times \frac{1}{4} = 1260$ for the 6 to 7 gearing.

The curves of the applied electromotive force (curves V and VI, Fig. 8) are obtained in the following manner: The armature was held stationary, while the field revolved at its normal rate. The reading of our electromotive force dynamometer then gave us a point on the electromotive force curve. The armature was then moved through a given angle, while the brush on the dynamo disc was moved through an angle corresponding to the ratio of gearing of the two machines. In this way another point was obtained on the curve. What we obtained was the electromotive force applied to the armature when there was no current flowing through it, and when the gearing was 3 to 4 or 6 to 7, according to the relative movement we gave the motor armature and the dynamo brush. It should be remarked that the armature curves marked electromotive force curves are obtained when the armature circuit is open, and therefore do not correspond to the actual condition of affairs when the armature is closed, as they do not contain the effects of armature reaction and self-induction.

The effective electromotive force of the armature given in curves III and IV, Fig. 8, were simply measured by opening the armature circuit and getting the potential difference on the motor terminals when the motor was geared to the dynamo with ratios 6 to 7 and 8 to 4. The difference between these curves and the curves of impressed electromotive force is the counter electromotive force, and is given by curves I and II, Fig. 8.

In Fig. 4 is given the armature current of the motor with a gearing of 6 to 7, and in Fig. 5 is given the current when the gearing is 8 to 4. If we compare these curves we see that the current is more irregular with the higher efficiency than with the lower. Again, comparing the curves of effective electromotive force for the two gearings, we see again that the irregularity is greater with the higher efficiency. If we consider that the current would follow this curve of effective electromotive force, but for the armature reactions and self induction, we can see that these effects have their good as well as evil side. The effective electromotive force is, of course, the difference between the applied and the counter electromotive forces, and if these are irregular, their difference becomes the more irregular as they are the more equal in value, that is, as the efficiency of the motor is higher; so that while in this machine whose maximum armature efficiency was made about 87%, the irregularity is considerable, it would be very much exaggerated in a larger motor whose armature efficiency might be 97% or 98%; and in this case, great care should be taken to produce a perfectly regular field. The effect of the armature reaction and self induction is to decrease these irregularities.

If we look at the curves, obtained with the motor experimented on we will see that the armature current is irregular and there-

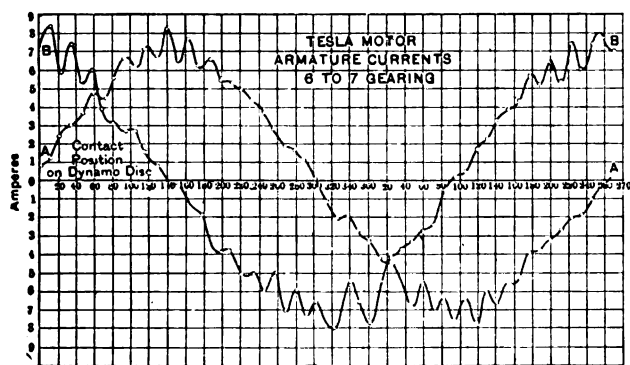


FIG. 4.

fore the actual heating would be greater than that calculated from sine curves; that is, the armature efficiency is always less and the drop in speed is always greater than the theoretical value, and may be very much less if the armature current is irregular. As has been pointed out, this fluctuation in the armature current would be exceedingly great if the self induction and armature reaction of the motor did not tend to wipe it out. The effect of the self induction being to damp the most the waves of shorter period, that is, the irregularities.

It seems to us that the most important curves we have obtained are those of applied and counter electromotive forces, effective electromotive force, and the armature current. They show at once the great importance of designing a machine whose applied and counter electromotive forces are both sine curves, and the

method may be easily used to experiment on actual machines and to find out if this condition is fulfilled. Again the comparison of the effective electromotive forces with no armature current with the fall of potential due to the armature current shows us that there is some beneficial effect from self induction in the armature. The principal results show that the special machine does not give us regular currents and electromotive forces but it is to a large extent due to the fact that in these small machines considerations of economy make it necessary to wind the field coils on spools instead of winding them through slots cut in the field iron.

In designing a motor to give absolutely regular electromotive force curves we must take two things into account; The field due

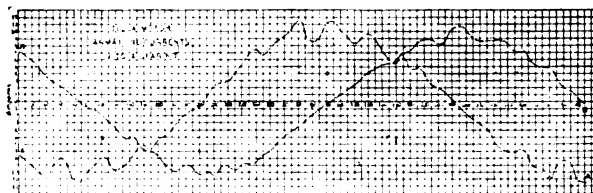


FIG. 5.

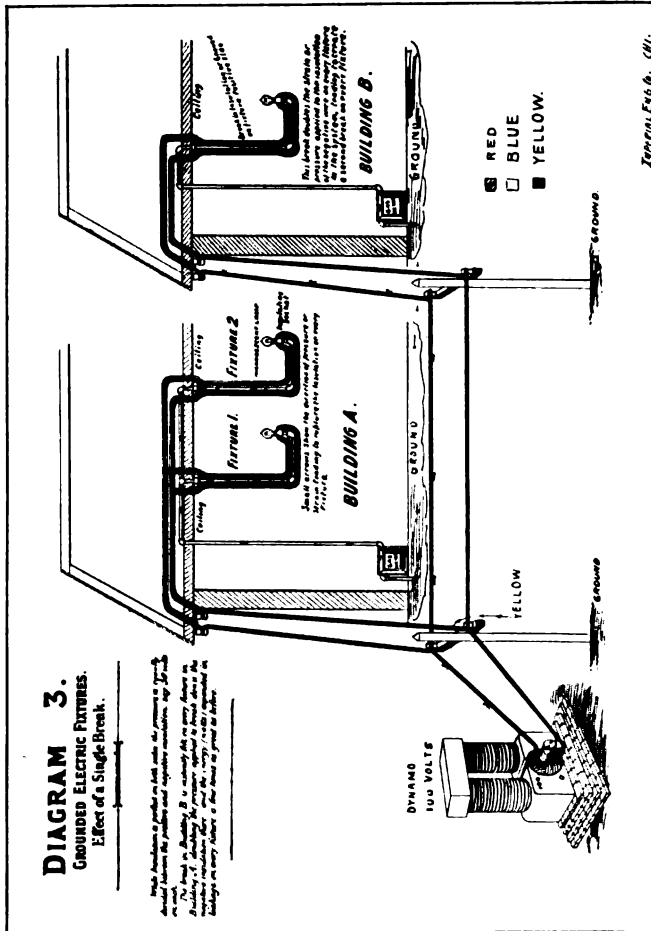
to the dynamo current must be regular, and the armature winding must be such that it will give a regular electromotive force in the regular field. To satisfy this condition in the field windings, projecting pole pieces should certainly be avoided. To satisfy the condition in the armature, would require an infinite number of armature windings, but it can be practically satisfied in the larger machines with a reasonable number of windings. It must not be understood that it is specially easy to accomplish this. We think, however, that the curves we have given show that the design of rotary field motors requires careful experimental study and we believe that such a study may be easily made, even for machines of large capacity.

ELECTRICITY AS A FIRE HAZARD.—II.

BY W. J. JENKS.

In the practical work of installing such systems of electric lighting as are illustrated in Diagrams 1 and 2, while it is sometimes difficult to insulate the conductors so thoroughly as to avoid annoying leakages on that portion of the system which is outside the walls of buildings, such leakages are in themselves a matter of much less danger than those which take place where conductors of opposite polarity, or having a considerable difference of electrical pressure, are of necessity brought near together in their passage through the walls and floors, and along the pipes or fixtures upon which incandescent lamps or similar translating devices are usually supported. This idea will be illustrated by "Diagram 3—Grounded Electric Fixtures; Effect of a Single Break." In this diagram the dynamo which has been illustrated in Diagrams 1 and 2, is assumed to be connected with an overhead system of conductors suspended from glass insulators on poles in the ordinary manner, a positive and a negative supply-wire being led into each building to be lighted. "Building A" is shown as being piped for gas, with two single-light fixtures suspended from the gas-pipe system, and thus in electrical connection with the ground, each of these fixtures serving as a support for the "insulating socket" in which the electric lamp is placed, and to which the wires which supply the lamp with current are permanently attached. "Building B" has one such gas-fixture, holding a single lamp and socket. The overhead exterior wires of such a system may or may not be covered with one of the ordinary forms of insulating braiding or wrapping. As they are supported only by suitable glass insulators, and surrounded by the non-conducting air, it is only necessary that they be kept at such a distance apart as that they shall not be accidentally swung or blown together. From the point where the positive wire enters the building to the lamp socket, and thence returning to the point where the negative wire leaves the building, it is desirable that each of the conductors be well covered with insulating wrapping. They may, however, be kept at such mechanical distance from each other in their passage through walls, floors and ceilings, and they may also be kept at such a distance from any gas, water or other pipes near which they may run, as to incur a less serious risk of grounding or short-circuiting contacts than exists where they emerge from a wall or ceiling, and approach each other at a fixture. Diagram 3 illustrates the strain which is brought to bear upon the insulation of both the positive and negative wires when each is brought into close proximity to a metallic pipe or similar conducting body, which, though normally carrying no current, and though not of necessity interfering in any manner with the proper operation of the system, so long as the conducting

wires are each suitably insulated from it by a proper covering, is a perpetual element of danger, because it is always ready to act as a bridge by which, when any break in the insulation of one wire takes place, the electrical strain may be carried over from the point of that break and applied as an intensified force tending



to break down the insulation of the opposite wire, precisely as the earth has been shown in Diagrams 1 and 2 to be a menace to a system of conductors buried beneath its surface. Indeed, in such a system as that of Diagram 3, the gas-piping of buildings and the fixtures attached thereto form simply an extension of the ground itself, the different gas services and the piping of fixtures reaching out from the earth like arms or tentacles, ever striving to attract from its legitimate circuit the current which may be carried by wires which come in contact with them. By means of such gas pipes, together with other systems of piping, carrying water, steam or drainage, the earth becomes, even in the upper stories of the tallest buildings, practically omnipresent, so difficult is it to avoid coming into contact with its numerous branches.

In "Building B" the break which is supposed to have occurred in the positive insulation allows a small flow of current to take place even when all the lamps of the system are extinguished (and when no current is usefully employed in producing light), along the red wire to the point of the break, where it is communicated to the gas pipe, and follows its metal to the ground through which it is conveyed to the piping system of "Building A," and the intensified electrical strain is applied to the two fixtures there suspended, tending to rupture the negative insulation.

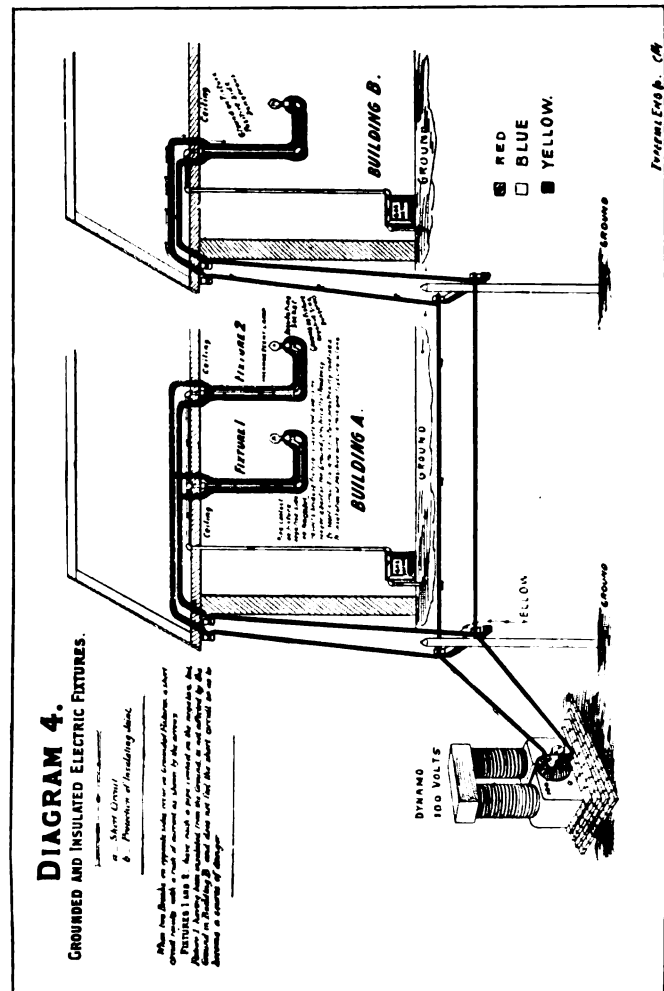
"Diagram 4—Grounded and Insulated Electric Fixtures," shows what occurs when the negative insulation of "Fixture 2" in "Building A" breaks down under the additional strain caused by the positive ground of the fixture in "Building B." The heavy arrows show how a rush of current is sent along the positive conductor of the pole line, the branch or service conductor supplying "Building B" to the point of rupture, from which it follows the gas-piping and the ground, along the line of the electrical tension or strain indicated in Diagram 3, until on reaching the break in the negative insulation on "Fixture 2," it returns to the dynamo by the negative wire. This rush of current is likely to cause the expenditure of a large amount of electrical energy at the two points of contact between the wires and the pipe precisely as shown in Diagram 2, with several additional features of disadvantage and danger. If the pipe, which under such circumstances becomes a conductor, is filled with gas, the heat developed at the point of contact may be expected to melt the metal and allow the gas to

escape and become ignited by the electric arc formed at this point of comparatively poor contact. Such an abnormal current has often resulted in heating the wires concealed within the walls of buildings, or on the fixtures, so as to set fire to the insulating covering, or to the wood or other combustible material upon which the wires may be supported, or by which they may be surrounded. Hence, such a short circuit as Diagram 4 depicts, might be the cause of a serious fire in each of the buildings. The same result in one of the buildings might follow if one of the ground connections were to occur on the line wire outside, as for example, if this wire were to come in contact with the metal of a gutter-pipe connected with the earth; or it might occur in consequence of a faulty insulation of the dynamo itself, by which the conducting portions became connected with the ground. From this it will be plain that the idea of bringing the conducting wires of an incandescent electric lighting system into intimate contact (but for the protection afforded by their insulating covering) with gas pipes or other grounded supports within the walls of buildings, was, after some unpleasant experiences, justly regarded by the managers of the first central lighting stations, the owners of isolated plants, the customers to whom electric light was supplied, and the fire insurance underwriters who assumed the risks of buildings and other property, as a serious hazard.

There have been found to be three ways of avoiding difficulty by leakage under such circumstances.

(1) By improving the quality or thickness, or both, of the initial primary insulation, that is, the wrapping of flexible non-conducting material which forms a part of the conductor itself as sold to the constructor. The "primary" insulation may be said to include whatever non-conducting substances stand between the current-carrying wire and supporting conducting material to which we are afraid the current will escape. The "initial primary" insulation means, as the phrase is here used, the rubber sheath or cotton braid or winding or other flexible wrapping which is originally applied.

(2) By adding to the "initial primary" insulation a reinforce-



ment of outside and usually rigid material, such as an ordinary glass telegraph insulator or porcelain or wooden cleat, a hard rubber tube, an insulating conduit, or a flexible material, such as a winding of rubber tape, forming a "supplemental primary" insulation so that the amount of resistance which the electrical pres-

sure will have to overcome before it can leak to any fairly good conductor, will be greatly increased. The combination of the "initial" and "supplemental" primary insulations is shown in Diagrams 8 and 4, and more clearly illustrated in "Diagram 5—(to follow) Comparison of Methods of Insulation in Electric System." It is exemplified wherever a covered wire is attached to a glass or porcelain insulator, or supported by a wooden or porcelain cleat.

(3) By the combination of one or both the foregoing methods with a "secondary" insulation which separates two sections of conducting material, neither of which is normally connected with the circuit, so that if a leakage is accidentally developed in one section it cannot pass to the other. A "secondary" insulation within the meaning of this definition is an emergency device, and is well exemplified in the common "insulating joint" by which the present rules of the Underwriters of this country require that all fixtures carrying electric lamps, or such lamps in combination with gas jets, shall be electrically separated from the gas piping of the building by which they are mechanically supported.

THE LOAD LINE IN TELEPHONE EXCHANGES.¹

BY A. V. ABBOTT, JUN., AM. SOC. C. E.

AMONG interesting load lines, those presented by the daily burden on telephone exchanges exhibit some features of peculiar interest, well worthy of professional consideration. Considering that some of the larger exchanges in this country are handling messages at the rate of 100,000,000 a year, the importance of a consideration of the exchange load line becomes apparent.

The shape of the load line in any exchange is evidently governed partly by the speed and facility with which the operators are enabled to perform the various evolutions described as necessary to make connections between the subscribers, and partly by the nature of the business done by the exchange. The work done by the operator, thus becomes an important governing factor in the load line.

The business of the exchange is complicated by the frequent necessity of trunking calls between outlying offices, for the growth of the exchange soon leads to the establishment of a number of branch offices connected between themselves and to the original center by means of trunk cables. When a message proceeds through two offices, it must, of necessity, pass through the hands of two operators and through two switchboards. To accomplish the business thus transferred, it is customary to locate in front of every operator a certain number of trunk lines extending to all the other offices in the exchange. At the receiving end the trunks from the through offices are brought to special sections of the switchboard devoted to trunking business alone. In the trunking sections no subscribers' drops are placed, the attention of the incoming trunk operators being devoted entirely to receiving connections over the trunk lines and completing them on the multiple located in front of them.

To determine the load line, it is now customary in nearly all the larger American exchanges to make frequent tests of the amount of business. To this end, recourse is had to what is termed the "operator's peg count." In front of each operator is placed a panel containing the subscribers' spring-jacks, each one bearing an appropriate number. The operator is supplied with a wooden peg, which at the commencement of the count she inserts in jack 0. As fast as calls are received she moves the wooden peg from hole to hole, counting calls something after the fashion of a cribbage board. At the end of each hour, the superintendents in the operating-room note the position of the peg, thus determining the number of calls which have been received by the individual operators. At the end of the day, the sheets bearing the facts thus obtained are tabulated and the results plotted in a convenient form for inspection.

A chart of the business transacted in a week by the main office of the Chicago Telephone Company shows some interesting data. At the time this count was made this office embraced about 5,000 subscribers, while the entire exchange numbered some ten offices, including about 10,000 subscribers.

From midnight to 7 o'clock on Sunday morning little business was done by the exchange, the number of calls in any one hour barely reaching 100. From 7 to 10, the business steadily increased, reaching at 10 o'clock a maximum of about 850 calls per hour. Another maximum occurs between 12 and 1, reaching about 875 calls. From this point the business steadily decreases, reaching a minimum between 2 and 3 on Monday morning. From 3 o'clock to about 7 there is a slight increase. At 7 o'clock the business of the day begins, the number of calls rising rapidly from 200 per hour at 7 o'clock to a maximum of 6,920 calls an hour at about 10.15. From 10.15 to 12.30 the business decreases, being reduced to 4,150 calls per hour during lunch time. From 12.30 to 2.15 the business again increases, reaching a second maximum of 5,950 calls. From this point a rapid decrease occurs, to the rate of about 500 calls an hour between 7 and 8 o'clock in

the evening. The curve at this point turns and slowly decreases again until about midnight.

Between 2 and 3 o'clock a slight increase takes place, due to newspaper business, while the minimum of the entire twenty-four hours is reached at 4 a. m., at a rate of about fifty calls an hour. Rather more business is done on Monday than any of the succeeding days, with the exception of Saturday. During Tuesday, Wednesday and Thursday the business decreases, reaching a minimum on Thursday. On Friday a slight increase occurs, while on Saturday the effect of the summer half holiday is plainly marked. Here it is evident that an effort has been made to transact the entire business of the day in the forenoon, the maximum being reached at 11 a. m., with a rate of about 7,600 calls an hour. From 11 a. m. the business drops sharply, there being no indication of any noon hour, but the holiday effect is also noticeable in an increased number of calls made during the evening hours, from 6 to 9 o'clock.

A study of the load line is particularly advantageous in adjusting the operating force to the business of the exchange in a way to make the quantity and quality of the service a maximum with a minimum of operating expense.

In a like manner the study of load lines forms an exceedingly valuable source of information in the location of branch exchanges and the distribution of subscribers' lines. The trunking of calls between branch offices has already been alluded to. It is quite evident that the establishment of branch exchanges increases the cost of operating, as it requires the expense of additional buildings, additional supervision and a general increase in the non-productive portion of operating expenses. Where, by means of a branch exchange the capital invested in the subscribers' lines may be decreased by shortening those lines, resulting in such a saving as to warrant the increase in operating expenses, a branch exchange becomes profitable. On the contrary, if the business in the district covered by the branch exchange is of such a nature as must necessarily come to the main office, the establishment of a branch exchange must be supplemented by such a large number of trunk lines as practically to extend the line of each subscriber into the main office. Thus, under such circumstances, the establishment of a branch exchange becomes an impediment rather than an assistance; as the speed of the service is reduced, greater expense is incurred, and no particular saving can be made in the capital expended.

The improvement in service which has resulted to the Chicago company during the past six months from investigations of this description has been so marked that a regular system of peg counting now forms one of the features of the operative service of the company, regular counts being made on the tenth of each month. A special count takes place whenever circumstances of so peculiar a nature arise as to seem worthy of investigation.

Exchanges in New York and Boston are following a similar course, deriving like advantages from the information thus obtained, and by means of an interchange of curves between the different exchanges the amount of valuable information obtained is largely augmented.

DR. NASH ON TELEPHONIC BACTERIOLOGY.

DR. ALBERT B. NASH, who has charge of the work at the hospital in Newark, N. J., where an investigation into bacteriology has been going on for some time, has made a special study of bacilli for several years. His attention was called to the claim that the telephone is dangerous from the manner in which it gathers disease germs, and he has begun an investigation of the subject.

"The idea," said Dr. Nash, "is that the germs are deposited in the instrument which the speaker holds close to his mouth, and the next person who comes along inhales these germs. Now, this is possible, but not probable. In order to get the disease of consumption it is necessary that some of the sputa from a tuberculous patient should be deposited in the instrument and then drying be inhaled by those who use the telephone subsequently. This is true, also, of diphtheria, except that the germs of that disease exist in the sufferer's throat. They must be transferred from there to the instrument, and to be dangerous the germs must be inhaled while they still have vitality. But I don't think persons suffering with even the initiative stages of diphtheria use, as a general rule, a telephone.

"There are millions of not necessarily pathogenic bacteria in the mouth of a healthy person, and of course it is possible that disease germs might collect in a telephone instrument. But the danger from germs is so great in every-day life that close attention is being paid to the subject. The germs are not dangerous in a moist state, but only become so when dry, just as, to use a common simile, one doesn't inhale mud, but when it turns to dust you do. If telephone instruments convey disease germs, so do the nickels that women put in their mouths while buttoning their gloves in street cars and the greenbacks that we so willingly handle. In the perspiration which collects on a pitcher containing ice water, one may find millions of germs which have been collected there from dust of the room."

¹ Abstract of a Paper read at the Annual Convention of the American Society of Civil Engineers, Niagara Falls, June, 1894.

THE ELECTRICAL ENGINEER.

[INCORPORATED]

PUBLISHED EVERY WEDNESDAY AT

203 Broadway, New York.

Telephone: 3860 Cortlandt.

Cable Address: LENGINEER.

Geo. M. Phelps, President.

F. R. Colvin, Treas. and Business Manager.

Edited by

T. COMMERFORD MARTIN AND JOSEPH WETZLER.

Associate Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue, Boston, Mass.

Western Editor and Manager O. KAMMETER, 1430 Monadnock Building, Chicago, Ill.

New York Representative, 203 Broadway, { W. F. HANKS.
Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada, - - - - - per annum, \$3.00
 Four or more Copies, in Clubs (each) - - - - - 2.50
 Great Britain and other Foreign Countries within the Postal Union " - - - - - 5.00
 Single Copies, - - - - - .10
 [Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1893.]

EDITORIAL ANNOUNCEMENTS.

Addresses.—Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of THE ELECTRICAL ENGINEER. Communications for the attention of the editors should be addressed, EDITOR OF THE ELECTRICAL ENGINEER, 203 Broadway, New York City.

VOL. XVIII. NEW YORK, JULY 11, 1894. No. 323.

CONTENTS.

EDITORIAL :—	PAGE.
Electric Elevated Railroads.....	30
Railroad Telegraphy and Telephony.....	31
ARTICLES :—	
Physical Analysis of the Conditions on a Circuit Containing Distributed Capacity and Self Induction when Subjected at One Point to a Simple Harmonic E. M. F. (Illustr.).....	31
The Work of Hertz.—II. (Illustr.).....	32
Experiments on Two-Phase Motors. (Illustr.).....	36
Dr. Louis Duncan, S. H. Brown, W. P. Anderson and S. Q. Hayes. Electricity as a Fire Hazard.—II. (Illustr.).....	37
The Load Line on Telephone Exchanges.....	39
ELECTRIC TRANSPORTATION DEPARTMENT :—	
Electricity on Elevated Roads.....	43
Steam and Electric Cable Ways for Logging and Canal Boat Towing.....	43
Explaining the Success of the Trolley.—The Schuylkill Electric Railway Co.—Electric Elevated Railway for Chicago.—An Electric Police Launch for Philadelphia.....	44
NEWS AND NOTES :—	
Dr. Nash on Telephone Bacteriology.....	29
Municipal Lighting Plant, Marblehead, Mass.....	36
Electric Lighting in Baltimore.....	36
Louisville Arc Light Globes not to be Painted.....	36
LEGAL NOTES :—	
Buckeye Lamps Free.....	35
Lamp Litigation.....	35
LETTERS TO EDITOR :—	
Coal Power Transmission.....	35
The Blowing of Alternating Fuses.....	35
LITERATURE :—	
MacFadden & Rey's "The Practical Application of Dynamo Electric Machinery".....	35
Cary's "How to Make and Use the Telephone.".....	35
REPORTS OF COMPANIES :—	
Interior Conduit & Insulation Co.....	35
INVENTORS' RECORD :—	
Classified Digest of U. S. Electrical Patents Issued June 26, 1894.....	35
TRADE NOTES AND NOVELTIES AND MECHANICAL DEPARTMENT :—	
Mr. Henry B. Oakman (portrait).—Sales by the Chas. E. Gregory Co.—A Pointer for Electric Street Railways.—General Electric Lighting Unit in the Manhattan Life Building, N. Y. (Illustr.).....	37
Iron Armored Insulating Conduit (Illustr.).....	38
The Bristol Recording Railway Voltmeter.—The Hill Self Looking Starting Switch. (Illustr.)—Power Transmission at Montreal.—Double Rubber-Core Wire.—Barriett Electric Motor and Dynamo Co.—The Perkins Three-Wire Switch.—Westinghouse Activity.—Another Electric Company for New Jersey.—Edison Extensions for Altoona, Pa.....	39
Ohio Brass Co.—"The Mineral Industry for 1893."—New Station for Flatbush Gas Co.—Edison New York Earnings.—Electricity on Staten Island.—Western Notes.—New York Notes.—Canadian Notes... ..	40

ELECTRIC ELEVATED RAILROADS.

THE formal announcement of the decision of the Metropolitan and Northwestern elevated railroads of Chicago to adopt electricity as a motive power on their lines, is the first step towards the practical realization, so far as this country is concerned, of a method which has been advocated here for the past ten years. With all the experience of the trolley roads to draw upon—and certainly their working and method of operation contain the essential elements of the proposed elevated railway methods to be adopted—it seems strange that elevated roads should have been operated by steam locomotives up to within a year or two back. The frequent practice of coupling one, two and even three trailers to a single trolley car and their successful running under the most severe conditions would of itself indicate the chances of success on a line specially designed for the operation of trains. But the undoubted success, technically as well as financially, of the Intramural Railway at the World's Fair and the now undisputed superiority over steam shown by the Liverpool Overhead Railway must settle once and for all the question of motive power for all intraurban traffic. We have seen much of late again of the comparisons as to the relative efficiencies of the electric method as compared with steam direct, of cost of coal, etc., but in the light of the figures now obtainable from results of actual practice, their instructiveness appears to lie more in the direction of how far such calculations may be from the actual facts. If there was a time when the elevated electric road was advocated on the mere grounds of cleanliness and freedom from noise, inseparable with the use of steam locomotives, that time has certainly passed and it remains now but to select the simplest and most durable methods of electrical construction to place the electric method beyond the reach of criticism. As pertinent to the conditions existing at Chicago we publish in this week's issue an article by Mr. George L. Thayer, in which he discusses various questions relating to the operation of the Chicago roads drawing his inferences from the results obtained in Liverpool and the Intramural.

Regarding the once mooted question as to the relative economy of individual locomotives vs. motor cars, there appears now to be little room for doubt that the latter will become the standard style at least on elevated roads, where the distribution of load plays an important part in the cost of the structure. The West Side Road which connects that part of Chicago with the main city transit systems, is to be a four track road for a greater part of the way, to allow of an express service. The line will cross the river on a four track way laid upon a draw bridge. The power is to be generated from four dynamos. Two of these are to be of 2,000 h. p. each, and will be counter parts of the great dynamos which ran in the Intramural Power House during the Fair. This, at that time, was the largest ever built, but since, four have been installed in Brooklyn, N. Y. and three in Philadelphia, Pa. The two smaller dynamos are to be of 1,000 h. p. The current will be carried from the power house over the line by means of a third rail placed at the outside of each service track. A sliding shoe contact hanging from the truck

of each motor car will take up the necessary current for the motors.

The preliminary installation will comprise fifty-five complete equipments each to comprise at first two powerful motors with the necessary controlling apparatus, and electrical air pump for the air brakes, and the subsidiary apparatus and appliances. The motors will be to a great extent similar to those used at the Exposition. Two motors only to each motor car are to be used at present, but eventually two additional motors will be placed on each motor car. With the two-motor motor cars four car trains will be run during the crowded hours of the morning and evening and three car trains during the hours of slack travel, at a speed of thirteen miles an hour including stops. With the four-motor motor cars the trains will consist of six cars and the speed will be increased to fifteen miles an hour.

The adoption of electricity on the Chicago roads is a subject for congratulation for the residents of that progressive city, but its effect will and must be felt in all cities of the country where such roads are now in operation or in contemplation. In the case of New York, for example, we are told that the managers of its elevated roads are watching the outcome at Chicago with much interest, but we fail to see why they should wait even that short space of time with the results of Liverpool and the Intramural already before them. We know, as a matter of fact, that the New York Elevated railway officials, ever since the first attempts of Daft in 1884, and later those of Sprague and Field, have kept close watch of the subject, though apparently indifferent. But there is reason to believe that action of some kind looking to the adoption of electricity will soon be taken, if for no other reason than the desire to hold on to its present patronage by affording the most comfortable method of travel in competition with the rival road which it must sooner or later have to contend with. Though still delayed, there is no longer any doubt that an electric underground railway will be built in New York city, whether by the city or by private capital. The cars of this road, driven, lighted and heated by electricity, will constitute a rival such as only those who have been compelled to ride home after a hard day's work, in ill-smelling, badly lighted and badly ventilated cars can appreciate. Even now the loss by the elevated roads due to these causes, of passengers who prefer the older and scarcely less rapid surface roads is no inconsiderable item. The growing patronage of the cable roads is a fact of which the evidence is easily obtainable any hour of the day; and, as a matter of observation, we can say that many of the riders make long trips.

While Chicago has thus adopted the electric overhead system we note the active work going on in Boston looking to the consummation of a rapid transit scheme under what is known as the Meigs plan, and a bill for granting franchises to a company is now before the Massachusetts legislature. The Meigs plans contemplate a mixed system of overhead and underground sections, the latter being adopted in congested districts. If the company receives the privileges asked for, there is little doubt that electricity will be adopted as the motive power; indeed plans with that end in view have long since been worked out.

There is, however, much doubt expressed among railroad engineers as to the feasibility of the Meigs inclined wheel, single rail method.

RAILROAD TELEGRAPHY AND TELEPHONY.

WHERE so much depends upon regularity of service in every department, as is the case on railroads, innovations are necessarily slow of adoption, and the most rigid conservatism has often delayed the introduction of improvements that had long since entitled them to recognition in other branches.

Public opinion has already compelled the general adoption of the air brake and of the block signal system on roads carrying a heavy traffic but recent events show that improvements are also coming from within, in the railroad management, due to the urging of the electrical staff. The record of these improvements is furnished from year to year by the papers read before the annual Conventions of the Railroad Telegraph Superintendents' Association which includes a most intelligent body of electricians in its membership. At the last Convention, just concluded at Detroit, was noted the first attempt at the adoption of motor-dynamos in place of voltaic batteries as current generators for railroad telegraph work. Mr. J. W. Lattig, superintendent of the Lehigh Valley Railroad, described the system of this type introduced on his own road and the Philadelphia & Reading Railroad, and instanced the fact that each unit, costing complete \$200, effected a saving of \$10 a month in zincs and jars alone. Another plant installed at Bethlehem, Pa., consisted of dynamos driven by water motor, and herein lies a suggestion which might be taken up by the electrical engineers of some of our large telegraph companies. At this convention, also, the use of the telephone in connection with railroad work was discussed. Mr. C. Selden, who read a paper on the subject, showed that the old objection of the absence of a record of the telephonic transmission had but little force considering that the Morse register had practically disappeared from telegraph offices and that the sounder afforded no more record than the telephone. The objection is, therefore, merely due to unreasoning prejudice. Mr. Selden advocated the use of the telephone, the sender spelling out the letters of each word so that the receiver can take them down conveniently. But the great utility of the telephone on railroads manifests itself, as Mr. Selden pointed out, in the fact that the general manager can in five minutes' conversation with his superintendents every morning, get not only the whole situation but also the minors details which under present conditions take hours in their transmission by telegraph. It was brought out in the course of the discussion that the Pennsylvania Railroad Co., availed itself largely of the long distance telephone in the transaction of executive business and that the Lehigh Valley Railroad was likewise an extensive user of the telephone; while the New York Central contemplates equipping nearly its entire road with the same service. As a matter of fact quite a number of roads are to our knowledge taking up this subject actively; the experience abroad, especially in Germany, would certainly warrant the adoption of the telephone in railway service of all kinds.

ELECTRIC TRANSPORTATION DEPARTMENT.

ELECTRICITY ON ELEVATED ROADS.

BY GEO. L. THAYER.

THE problem of operating railroads by electricity as a motive power has sprung into great prominence within the last few years owing to its adoption by several elevated roads, and it is along these lines that the operation of long roads by electricity will be reached. Elevated road practice is in many respects intermediate between street railway and steam railway practice.

In 1888 Mr. F. J. Sprague made some experiments on the New York elevated roads looking towards the displacement of the steam locomotives. Considerable data in regard to speed, coal consumption, etc., were obtained, but for various reasons nothing came of these experiments. It remained for England to take the first steps towards the use of large motors and heavy trains. The City and South London Railway, an underground road, has been running several years with a fair degree of success. A year ago the Liverpool Overhead Railway was opened for traffic. This road is of interest because the conditions under which it is operating are those of the American elevated roads. The Intramural road at the World's Fair was the next one to be completed, while the "Metropolitan Elevated" of Chicago will probably be open for traffic before next fall.

One of the first problems which confronts us is: "How many cars are there to be to a train?" The standard steam elevated train consists of from three to five cars and one locomotive. The locomotive must be made in units of some considerable size and moreover requires two men to operate it. Then again an under-loaded steam engine is not as economical a machine as an under-loaded motor. Hence the necessity of trains of some size. Cutting down the trains does not increase the ratio of the weight of train to the number of passengers as much with electricity as with steam. In the first case, a load of eight or ten tons and in the second twenty-two tons for motive power is being hauled over the road. In respect to the train crew, with electricity it will be one man per car for any size of train. With steam there are six men for a five car and three men for a two car train.

The conditions then are more favorable for small trains with electricity. The Liverpool Overhead Railway runs a two car train. This train service, however, would not do for the hours of heavy traffic. The headway between trains should at no time be much less than the distance between stations. This would give a train every $1\frac{1}{2}$ minute, or with a two car train, one car every 45 seconds. The maximum capacity of the Alley road at Chicago is 50 per cent. greater than this with only one terminal track, and such an arrangement could not begin to handle the traffic during the rush of the day. A two train service would then be the thing for the middle of the day with heavier trains mornings and nights. A possible arrangement is as follows:

The motor cars are to be housed at one end for the controller and motor man. On light trains during the middle of the day, two motor cars with the housed ends at the ends of the train are to be used. The two platform ends would be together and controlled by one guard. Two motors per car to be mounted on maximum traction trucks. All four motors to be operated from the controller in either motor car; additional cars to be cut in, in the middle of the train. The trail cars to be so wired as to bridge over the gaps between the two motors.

This may be objected to because of the amount of copper necessary to wire the cars and the loss of power entailed. This is something, but there are advantages which offset it. Using, say, No. 8 copper for the car wiring, for five cars 3,800 feet, costing in the neighborhood of \$375 would be needed. With the motors all in series the resistance would be .77 ohm and the drop with 75 amperes 55 volts. This combination on the controller is not a running notch and in any case a speed attained on that notch for slow running would take a much smaller current. With the motors two in series and two in parallel the resistance drops to .22 ohm and on the last notch to .07 ohm.

I think that a good method of connecting the wiring between cars could be worked out. The advantages would be that the trains would be double-ended and time as well as the services of a man at the terminals in coupling would be saved. The motor-man needs only to change ends and as soon as the passengers have gotten aboard, the train is ready to start. The best time that can be made on the elevated roads in switching at present is three minutes per train. If the time were reduced to two and a half minutes, the capacity of the terminal would be increased 20 per cent. and where track room down town is expensive, this means a good deal. The capacity of a two-track terminal would be 40 and 48 trains per hour respectively. Another thing is that by means of maximum traction trucks the two driving axles sustain two-

thirds instead of one-half the weight of the car, increasing the traction one-third. Two motors instead of four motors come on one span of the superstructure. A saving in load of six tons on a span must certainly make some difference, although probably a small one on the cost of the superstructure.

TABLE I.

	Liverpool. 2 Cars.	Intramural 4 Cars.	Alley L. Steam. 5 Cars.	Alley L. Elect. 5 Cars.
Weight of train, loaded.....	88.25 tons	87 tons	115 tons	95.5 tons
Weight of motive power.....	6.35 "	8 "	28 "	8 "
Weight on drivers.....	13.75 "	28 "	20 "	25 "
No. Pass. seats.....	114	386	240	240
Weight of motive power per Pass.....	125 lbs.	48 lbs.	234 lbs.	67 lbs.
Weight of empty train per Pass.	553 "	380 "	280 "	650 "
Weight on drivers, with rolling friction.....	36%	32%	17½%	36%
Maximum possible acceleration.	1.96	1.68	.90	1.40

What is the maximum and what is the average H. P. required to carry this train over the road under the required conditions? Take for instance the train service upon the "Alley L." as something tangible.

CONDITIONS.

Length of line.....	8½ miles.
Number of stations.....	23
Number of stops.....	23
Time of trip.....	40 minutes.
Time of standing still at each station.....	15 seconds.
Average speed.....	13 miles.
Average distance between stations.....	2,040 feet.
Number of cars per train.....	5
Weight of empty car.....	14 tons.
Total weight of loaded car.....	17½ tons.
Motors.....	3,800 lbs. each.
Weight of two equipments complete.....	8 tons.
Total weight of motor car.....	21½ tons.
Total weight of train.....	95½ tons.

A small part of the work of the motors is used in track resistance from hauling the train over the road, but mainly in getting up speed between stations. The track resistance at such speeds as are attained on elevated roads is practically constant and may be taken at 6 pounds per ton. The maximum traction may be taken at 18 per cent. of the weight on the drivers. An acceleration in speed of 1.15 feet per second is possible, which is considerably in excess of what will be required.

The rates of acceleration are assumed as follows, being based upon present elevated railroad practice:

Getting up to 10 miles per hour....	$p = .875$ feet per sec.
" from 10 to 25 miles per hour, ..	$p = .500$ " " "
Slowing to stop.....	$p = 1.875$ " " "

TABLE II.

SPEED.	DISTANCE.	TIME.
0-10 miles $p = .875$	117 feet.	16.8 sec.
10-25 " $p = .500$	1,090 "	40.0 "
Constant $p = .0$	368 "	9.5 "
25-0 miles $p = 1.875$	490 "	26.7 "
	2,040 feet.	90 sec.

These results give:

Time of a single trip 38 minutes; average speed $13\frac{1}{4}$ miles per hour; maximum speed 25 miles per hour. A power of making up time exists under the conditions named as the drawbar pull of the motors may be increased 25 per cent. without danger of slipping.

The horse power required and an idea of the irregularity of the station load can now be determined. The energy in getting the train under way for one time is Mv^2 where M is the mass of the train and v the velocity in feet per second. Twenty-five miles per hour is the maximum speed. The energy in the moving train then is 135 H. P. minutes. The track, resistance from one station to the next is 25 H. P. minutes. Getting up speed is then the main work of the motors. As the energy in the train varies as the square of the velocity, for small changes in the maximum speed, double the change in energy is required to haul the train over the road. If the maximum speed is reduced from 25 to 23 miles per hour, the fuel consumption will be reduced 15 per cent. The following table shows this increase in power while the average speed increases in

a much smaller ratio. This table has been calculated upon the basis of a uniform acceleration from start until the brakes are applied.

TABLE III.

Uniform acceleration with.. 95.5 tons.
Braking " 1.875

Maximum speed.....	10	15	25	30
Average ".....	5	7	10½	11
Average H. P.	7	18	64	96
H. P. minutes per mile	84	154	368	518

A comparison of Tables II and III shows the gain to be derived from making a quick start. Under the conditions of Table II, we have a maximum speed of 25 miles per hour with a mean speed of 18½ miles per hour. The train gains speed rapidly up to 10 miles per hour with a slower gain afterwards. In Table III, third column, where the gain in speed is uniform, we have the same maximum speed, 25 miles per hour, while the average speed is only 10½ miles per hour. The energy required for a trip is the same in both cases, while the speed in the first is 28 per cent. greater. The inference is obvious. The trains should be brought up to speed as quickly as possible. The increased traction of electric motors placed under the cars gives electricity a considerable advantage over steam. There is a limit to this process, however, for a point is soon reached where the increased size of motors and the increase of fuel per H. P. due to fluctuations of power equal the saving made theoretically in quick starts.

Including stops the average power developed by the motors is 94 H. P. or practically one H. P. per ton of train. During the time that the motors are using power the average power consumed is 155 H. P. The maximum H. P. would probably be developed by the motors when first thrown into 2 in multiple and 2 in series at about 10 miles per hour. This would be about 250 H. P. for a few seconds only. Theory is not of much service, as the entire character of the maximum load upon the motors depends upon the way in which the motorman handles his controller and can only be obtained accurately by experiment. We may assume that the maximum station load is ½ in excess of the mean load as the fluctuations of each train average up to a considerable extent. Under the best possible conditions the per cent. between the I. H. P. and the H. P. delivered by the motors is 60 per cent. This gives 155 mean H. P. and 200 maximum H. P. at the power house.

In the report of the Liverpool elevated road a test of the power required by a train is given. The average speed is 12.3 miles per hour, a little less than the conditions upon which we are figuring, the distance between stations slightly greater, 2,300 feet. For a train of 95 tons it figures out to be 125 H. P. at the station. On the Intramural, the stations were 1,900 feet apart and the average speed in the neighborhood of 11 miles per hour. On July 4th, fourteen four car trains required 1,775 H. P. or 180 H. P. for a train of 95 tons. The important factor, the maximum speed attained is not given, but knowing that it was very close to what is taken in these calculations, it serves the purpose of comparison. It would seem that the coal consumption can be based upon 150 H. P. per train and the station equipment upon 235 H. P. For a three minute service, 4,000 H. P. would be required at the power house. Five direct connected units would be a probable arrangement. One unit would always be in reserve. Compound non-condensing engines would be used. If the number of engines running at one time were kept as small as possible, I do not believe that on a road of this size the fluctuations of current would be so great as to overload the engines one moment and then fall off in a few minutes, causing the low pressure cylinder to act as a drag upon the high pressure, as has so often been found with compound engines running non-condensing on street railroads. If water for condensing could be had, it *might* be economical to adopt triple expansion engines working at 150 lbs. pressure. This however, is a little in advance of current steam practice, though unquestionably the tendency is towards higher pressures and multiple cylinder engines. At the present state of our information an electric road would require the same weight of coal as a steam road. It is a question of the difference in cost of anthracite coal at \$7.50 a ton and soft coal at \$2.50 or less, if slack be used. Using the operating expenses of some other roads as a guide, it is probable that the operating expenses of the "Alley L." could be reduced 10 per cent. or \$260.00 per day using electricity.

There are many interesting details to be worked out in the actual design of an electrical equipment, such as the method of taking current from the trolley rail, etc. The question of how to construct a return circuit of low resistance and the construction of a mechanically good joint are among the first to come up. As the rails are not covered by pavement, inspection and repair do not present as serious difficulties as with surface roads. There is no question as to the abandonment of the supplementary wire. Assuming that one-half the resistance is in the bonds and rail joints with four 90-lb. rails as a return, the equivalent copper conductor would have an area of three square inches. The cost of a copper supplementary wire which would have any marked influence

would be prohibitive. Cross bonding between rail every 1,750 feet and between tracks at every station would pretty thoroughly do away with trouble from bad joints. The length of the bond wire is a considerable factor. A number of tests on electric roads in western and central New York seemed to indicate that the resistance of the metal in the bond had a well defined influence on the total track resistance. The experiment seemed to show that the resistance of the joining surfaces was not the only important factor. It would be hard to say exactly how much this was because we found no two pieces of track enough alike in other respects to draw other than general conclusions. It is also evident that the bonding should have enough spring in it to withstand the contraction and expansion of rail joints. With a good method of bonding the drop during heavy traffic should not exceed 50 volts four miles away from the power house.

As to utilizing the iron structure as part of the return, the girder construction is such as to make poor joints at the ends, and even if there were good iron to iron connection, the condition of iron columns 15 or 20 volts between the ground would be conducive of complaints on a wet day from the public.

The question of a design of motors I have not touched upon as the various electric manufacturing companies can furnish equipment for any reasonable set of conditions. I believe, however, that four pole single reduction motors with a well constructed series-multiple controller with a set of changes which does not overload one motor at certain notches is the best at the present stage of the art. The poor old gearless motor seems to be a thing of the past except perhaps for high speed service with few stops.

STEAM AND ELECTRIC CABLE-WAYS FOR LOGGING AND CANAL-BOAT TOWING.*

BY RICHARD LAMB, ASSO. MEM. AM. SOC. C. E.

THE problem that confronted the writer was to design a cable-way that could be operated at least half a mile, and with the power placed upon a boat or car located at a navigable point. It should gather in the logs for at least 500 feet on either side of the cable-way proper, and by its means bring the logs to navigation at a reasonable cost for operation. It was necessary that such a system should be easily and cheaply moved from place to place as the total area of forest to be cleared at any one setting would not require much time. Trees had to be used as supports as they are the only practicable foundation to be found in a swamp. It was evident that any steam system would have to be worked in practically a straight line. To attempt to find trees in a straight line would be difficult if the distance apart was not great, but after running a number of lines, it was found that in a forest of ordinary density a practically straight line could be gotten with trees at from 100 to 225 feet apart. The writer's system was designed for long spans in consequence.

Iron brackets in the shape of a T are used for passing by the trees and for supporting the cable. The T iron bar straddles a 1½ x ½ inch iron pin driven into the tree at a height of about 13 feet from the ground. Dogs on the ends of the arms attached to the T iron bar are driven into the tree on either side, and a chain wrapped around the arms and held from slipping by upset knobs keeps the arms from spreading. This chain also serves to hold an iron snatch-block.

A swinging sheave is hung from the end of the T iron bar on which is an iron band curved rearwardly and downwardly, which acts as a fender and also replaces the hauling cable should it become disengaged from the hanging sheave. The steel saddle at the end of the T bar is provided with boiler steel U plate. Two wedges pass through the U plate and saddle in opposite directions to each other. By means of these wedges the U plate clamps the main cable rigidly to the saddle. On the head tree two sheaves are placed, one on either side, and on the tail tree a 2-foot steel sheave is chained.

The endless ½ inch pulling cable, made of nineteen strands of steel wire, is passed through the sheaves on the head tree and on the brackets and around the large sheaves on the tail tree. Two turns are made around a two-foot elliptical grooved sheave, run by a twenty-five H. P. reversible engine for a ½-mile line. After the ½-inch cable is out, the main cable is hauled into the swamp by steam power by means of the hauling cable.

The cars are made with a hanging frame supported by a horizontal axle passing between the wheels. By this arrangement the hanging frame can remain vertical even when the car is climbing the steep grade of the catenary on approaching the saddles and when passing over them. The hauling cable is attached rigidly to the swinging frame at a point located so as to clear the swinging sheave, and the hauling cable is practically parallel with the bearing cable at all parts on the line.

It became necessary, however, to design a system that practically would not be limited as to the distance it could be operated. To this end an electric cable-way was built. As economy and ease in moving depended upon being able to use a few supports, or, in

1. Abstract of a paper read at the Annual Convention of the American Society of Civil Engineers, Niagara Falls, June, 1894.

other words, long spans in the forest, it was evident that no system of traction was available. The direction of the force should be parallel to the bearing cable. This suggested the use of a $\frac{1}{2}$ -inch cable, made fast at both ends, to be supported at the tree brackets by a narrow saddle, so designed as to enable the cable to change its course and not to become disengaged when the car passed over it.

The motor is made with the car like the steam cable-way, with a hanging frame having attached to it an elliptically grooved sheave which is revolved by means of a newly patented worm or wedge gearing, driven by a 5-kilowatt electric motor with vertical shaft, all attached to the swinging frame of the car. By taking a couple of turns of the $\frac{1}{2}$ -inch cable around the elliptical grooved sheave, when the motor revolves the gearing, the sheave winds up, and at the same time plays out on the $\frac{1}{2}$ -inch cable, thus pulling along the car.

When it reaches the bracket, the small cable is lifted from the saddle momentarily, and the car can take a new course. Hence we are not limited to operating in a straight line. The main cable is used as the conductor. It is insulated at the brackets by mica-nite placed between the saddle and the iron T-bar, and the current is prevented from passing down the frame of the motor by a mica-nite insulator at the point on the frame where the axle-box joins the frame proper. The points of insulation are each provided in their construction with hoods to shed water.

The worm or wedge gear deserves especial mention. It was invented in 1891 by a Mr. Welsh, of the Glen Cove Machine Company. It differs from an ordinary worm gear in that it has 25 per cent. more contact surface, moves two teeth of the gear wheel at each revolution of the worm, and works on the principle of a wedge rather than an incline plane. The worm gear especially made for this electric motor is designed to work both ways, and has ball-bearings at either end of the worm, to lessen the friction and thrust. The gear wheel, worm and ball-bearings are encased in a jacket filled with oil. Thus the minimum loss in power is effected between the electric motor and the elliptical grooved wheel. The electric motor is run at 1,340 revolutions per minute, giving a speed to the motor proper, with the gearing, of six miles per hour, which is the desirable speed for logging purposes. The current is taken from the main cable through the wheels, thence through the axle to the axle-box of the hanging frame. Here an insulated copper wire connects it with the rheostat. The return current is passed through the axle of the elliptical grooved wheel; thence on the $\frac{1}{2}$ -inch wire to the brackets; thence on a wire down the trees to the ground.

In the system now built 220 volts are used. The trial was made at the works of the Trenton Iron Company, Trenton, N. J., along the banks of the Delaware and Hudson Canal. It was found that heavy logs could be pulled from a distance up to the cable, by the same method as employed in the steam system. When two motors are used, the empty cars are switched off the cable and motors are exchanged, the motor which hauled the empties taking back the loaded ones, and vice versa. This system of electrical cable-way can be used for an endless variety of purposes.

A valuable and additional service for this new motive power was also tested, viz., towing canal boats. It will be obvious that a cable can be located on a towpath, and at either end of the canal can be built sheds in which there would be a large number of motors ready to go out. On application of a canal boat captain, a motor will be allotted to him and he will proceed, towed with a tow-line by the motor, the rheostat lever being operated from the boat by reins, or he can sit upon the seat of the motor and handle the lever, no experience being necessary to stop or make the motor go. When a boat meets another they change motors and proceed.

The cheapness with which this system can be built and operated would insure the saving of thousands of dollars in the operation of such a canal as the Erie, especially as that canal has at its disposal the almost limitless electrical resources of the great Niagara cataract.

EXPLAINING THE SUCCESS OF THE TROLLEY.

"THERE is no use in our trying to compete with the trolley lines," said a railroad man the other day, to a reporter of the *Philadelphia Record*, as he glanced ruefully over some figures, which showed a decrease of \$40 a day in his company's receipts from suburban travel on a branch line since the opening of a trolley road. "We have to give too much to our patrons," he continued. "We provide handsome terminals, fine suburban stations, heat, water, light and a seat for every passenger, while the trolley lines furnish almost nothing but transportation. They furnish no stations; crowd the passengers in, so that many have no seat, and in that way manage to make money. We can't do things that way, and so I see no money for us in trying to compete with the trolleys. Of course, they can't touch us on long-distance traveling, but in the near future I expect to see them absorb a large amount of our suburban travel."

THE SCHUYLKILL ELECTRIC RAILWAY CO.

THE CAR EQUIPMENT Co., of Philadelphia, has purchased the controlling interest of the Schuylkill Electric Railway Co., of Pottsville, Pa., and it is their intention to extend the line about twenty-five miles in and around Pottsville, connecting St. Clair, Middleport, Trement, Schuylkill Haven and other towns nearby with Pottsville.

Jesse Newlin and Robert Allison have retired from the old board of directors and W. A. Barritt, Jr. and Charles H. Barritt, president and treasurer, respectively, of the Car Equipment Co., of Philadelphia, have been elected to fill the vacancies. J. B. Stuart, of Philadelphia, has been appointed electrician and general superintendent and his success in the construction of the Pottstown, Camden and Gloucester roads will assure a perfect system for the roads at Pottsville.

The Schuylkill Electric Railway Co. has a capital stock of \$150,000 which was raised by popular subscription from the residents of Pottsville and was fully paid. The road was originally built out of the capital stock, and the improvements or betterments from time to time were contracted for out of issue of bonds; the road has a bonded indebtedness of \$95,000. It can readily be seen that there is a sound financial basis to work from in the reorganization and improvement of the road. The Schuylkill Electric Railway proper consists of ten miles of road with eighteen car equipments, about half of which are new and the remainder consisting of Short apparatus which will be, no doubt, replaced in the very near future with more modern equipment. New feeder wire will be put in on the entire system to supply sufficient and additional power for the extra car equipment that will be added and a new car barn will be built at Palo Alto. The entire system will be overhauled and will be put in a first class position as soon as possible.

ELECTRIC ELEVATED RAILWAY FOR CHICAGO.

The West Side Elevated Railroad, of Chicago, is to be entirely operated by electricity. The success of the Intramural Electric Railway at the World's Fair which transported during the short time the Exposition was opened not less than 5,808,895 passengers, without a single accident and without any serious stoppage, has proved an agitating leaven in the minds of the steam railroad men, only wedded to their steam power until a more economical system can be found. After careful and thorough investigation of every possible system of passenger car propulsion, the president and directors of the West Side road decided that electricity was the most economical system, and the great generators and powerful motors are already under construction in the Schenectady shops of the General Electric Company, where those for the Baltimore and Ohio Railroad Company are nearing completion.

The company operating this road is the Metropolitan Elevated Railway of Chicago, the president of which is Mr. R. Summers Hayes, president of the St. Paul and Duluth Railroad; chairman of the Reorganization Committee of the Atchison, Topeka and Santa Fé road and director of the Metropolitan Traction Co., New York.

According to the present indications the electric should be running on the elevated by the middle of November next.

The significance of the step towards economy in the adoption of electricity as the propulsive power instead of steam will be better understood when it is stated that if the New York elevated railroad system had been operated in 1891 by a system similar to that employed on the Intramural Railway, instead of by steam, the shareholders, it is estimated, would have been richer by over three quarters of a million dollars.

AN ELECTRIC POLICE LAUNCH FOR PHILADELPHIA.

AN electric launch service is to be at once established as an auxiliary to the Philadelphia police service on the Delaware river. The General Electric Launch Co. has filed a bid of \$1,960 for the first boat, and other bids have been filed for the engine, charging dynamos, etc. The new boat will be what is called a "sneak boat," doing away with the rowboat of the Harbor Police, which is managed with much difficulty when the water is at all rough. This boat will enable the officers to approach river thieves and petty pirates silently, and is regarded by the police as a valuable recruit. It will also be availed of in connection with the river fire service.

HARTFORD, CONN.—Joseph Osgood and Thomas Capewell of New York, who are understood to represent the American Traction Company of Philadelphia, have closely inspected the system, lines and plant of the Hartford Street Railway Company, and it is believed an effort is being made to buy up the Hartford street railway lines.

LEGAL NOTES.

BUCKEYE LAMPS FREE.

JUDGE DALLAS, of the United States Circuit Court, Philadelphia, has rendered a decision against the General Electric Company to the effect that the Edison incandescent light patent has expired, so far as the Buckeye Company is concerned. This is in line with the opinion given by Judge Ricks, of Cleveland, who, as will be remembered, exempted the Buckeye lamp on the ground that the Edison patent had been limited in its duration by the owners themselves on such a way as to stop them from claiming that their patent was entitled to an injunction against the Buckeye Co.

THE CITIZENS' ELECTRIC LIGHT, HEAT AND POWER CO., of Lancaster, Pa., has been sued by the parent and local Edison interests for infringement of the Edison lamp patents, and has filed its answer denying infringement, alleging that the patent has expired, and stating that it uses the Columbia, Buckeye and Stopper lamps, none of which infringe the patent even if it were not already null and void. The case is in the U. S. Circuit Court at Philadelphia.

LETTERS TO THE EDITOR.

COAL POWER TRANSMISSION.

I NOTE in the July 4th issue of THE ELECTRICAL ENGINEER the interesting and novel suggestion that the Paris Exposition of 1900 be furnished with its motive power by means of current generated at distant coal mines and transmitted by high voltage methods. This idea is worthy of the "forward" attitude assumed by your journal toward all new work of real promise as an engineering development, and I would like to see its feasibility further discussed.

It would be cause for pleasure if an American suggestion of this kind were adopted as a means of adding to the usefulness and glory of the show at which France will pick up the gauntlet thrown down to the world by Chicago last year.

It occurs to me, however, that one objection to your brilliant plan would be that as an Exhibition is an *exhibition*, it would be a little less of an exhibition if part of it were set up 100 miles away. It would be desirable to install one of your generating units complete at Paris in order to show what was being done 100 miles off by its working counterparts.

The estimates given in your article are rough and crude, though doubtless fairly approximate. But I should like to know whether allowance is made for utilization of the by-products accruing from the production of the fuel gas which is to drive the big engines. I would also like to know whether some allowance as to fuel should not also be made for the low grade "culm" that cannot be shipped. I am not aware of the conditions in France, but here our mining regions and towns are encumbered for miles with artificial mountains of wasted coal dust and refuse. Any consideration of the problem you have put forward should take into account the culm pile.

As one who is familiar with the aspect of Chicago, I should say that one of the greatest mercies that could happen to the great city by the lakes would be to be able to burn all her coal at a distance in the way you suggest, and thus receive only its energy for light, heat and power.

Surely this is not in anywise impossible to modern electrical engineering, and I therefore hope your idea will have a trial, on the grand scale suggested, at the Paris Exposition of 1900.

E. L.

New York, July 6, 1894.

THE BLOWING OF ALTERNATING FUSES.

In the June 6 number of THE ENGINEER, appears an article exhibiting diagrammatical tests of the effects of alternating currents or resistance of fuses by Prof. Dugald C. Jackson, and R. J. Ochsner, and their final statement setting forth the idea that the blowing of a fuse under certain conditions, results from the mechanical shaking to which an alternating current fuse is sometimes subjected when not tightly clamped by the terminal screws; and your editorial on same, wherein you suggest reason and argument implied by such a theory, and your further views suggested on the subject, accompanied by the fact of the practice of a few central station managers:—To which we desire to add our views on the subject deducted from experiment along another line, which however gave an opportunity to observe these points; though at the time employing a constant current.

By the use of a device employing a movable plate upon which was mounted a fuse for the protection of the device, we found, on making and breaking contact through a movable plate, that whenever the demand reached within about 60 per cent. of the capacity of the fuse, throwing the plate to break the contact invariably caused the fuse to blow, notwithstanding the screws were down tight.

From this we are led to believe that the action is due, not, as you indicate, as the probable idea of the authors, that this vibration of itself, *caused by the molecular magnetic change is sufficient to change the physical character of the metal*, and give rise to increased resistance, but rather to the *mechanical vibration* (independent of current action), *causing excessive magnetic molecular changes, or molecular bombardment*, which so changes the physical character of the metal as to give rise to higher resistance; since the body is probably occupied with two disturbances electrical or magnetic molecular disturbances, and mechanical or vibratory molecular disturbances. We are led further to believe, that the state of a body on passage of an electrical current tends to increase the fluidity of the vibratory molecular disturbances, as shown in the converse action on making contact, throwing the fuse into the circuit when it is at complete magnetic rest, the fuse remaining intact. The formation of an arc, as suggested, is substantiated by experience.

IKE ULLMAN.

BIRMINGHAM, ALA., June 28, 1894.

LITERATURE.

The Practical Application of Dynamo Electric Machinery. By C. K. MacFadden and Wm. D. Ray. Chicago: Date & Ruggles, 1894. 167 pages, 4x6. Flexible cover. Price, \$1.

THE work before us is of the nature of a series of practical talks on the method of handling dynamo electric machinery and auxiliary apparatus in the departments of lighting and power transmission. After describing in a simple way the principles on which dynamo electric machinery is based the authors take up first current distribution, showing the losses in conductors, how they must be allowed for and the method of calculating the size of conductors to carry given currents. This includes, not only the continuous current two and three wire systems for lighting, but street railway trolley systems as well. The alternating system of distribution, both single and multiphase, next claims their attention, and its principles are likewise clearly set forth. The various types of dynamos and their application and practice, their method of connecting up and the causes of troubles in them give the authors opportunity for introducing a number of very practical hints to those in charge of this class of apparatus. In the same way they treat of arc lamps and electric motors and storage batteries. A final chapter is devoted to electric heating, including cooking, welding and metal working generally, and hints in relation to station instruments and switch boards.

This little work ought to be in the hands of every station employé. The information it contains is given in a form and in a manner which will make it acceptable, not only to this class of readers, but to all who are placed in charge of dynamo electric machinery, or who desire to improve their knowledge on these points.

How to Make and Use the Telephone. By Geo. H. Cary. Bubier Publishing Co., Lynn, Mass., 1894. 117 pages. 5x7 inches. Price, \$1.

IN this work the author describes the method of making telephone outfits, including receiver, transmitter, call bell and a simple switch board. The text is illustrated by diagrams. A number of appendices describe the Gibboney long distance telephone system, involving the use of the phonograph as an intermediate step; another, on how to make the phonograph, and a third gives an abstract of a lecture on the telephone by Prof. Puffer. The work is provided with an excellent index.

REPORTS OF COMPANIES.

INTERIOR CONDUIT & INSULATION CO.

THE subjoined is an extract of the minutes of a special meeting of the Executive Committee of the Interior Conduit & Insulation Company, held at the offices of the company, on Monday, June 11th.

"Whereas, the net earnings of the Company from manufacturing and other sources have been permitted to accumulate for the past three years, and after charging off to Profit and Loss Account some \$38,000, arising from expenditures for experimental purposes hitherto carried as an asset, and such net earnings now exceeding \$100,000 represented by Bills Receivable, Material and manufactured goods on hand, and

Whereas, it is deemed sound policy to keep the Company in strong financial condition by retaining its earnings in the form of quick available assets, instead of distributing any part in cash at this time, therefore be it

Resolved, that the Executive Committee recommend to the Board of Directors that a dividend of five per cent. be declared upon the outstanding stock of the Company, to represent a part of the past net earnings, and it is further

Resolved, that this dividend be payable in scrip, to be converted into fully paid Capital Stock when the proper steps have been taken to provide for an increase of capital stock and that pending such conversion the aforesaid scrip shall, so far as legal, possess all the qualities of stock and be entitled to all such dividends or privileges as may hereafter at any time be declared upon the outstanding capital stock, and provided further, that such scrip shall be converted into stock before the declaration of the first cash dividend."

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS
ISSUED JUNE 26, 1894.**Accumulators:—**

Accumulator Plate, C. J. Barbier, Lyons, France, 531,970. Filed Jan. 12, 1894.

Consists of a flat lead box having its opposite sides provided with inwardly projecting pins extending past one another for holding the active material in place.

Alarms and Signals:—

Thermal Alarm, H. F. Maxim, Norfolk, Va., 522,032. Filed Aug. 31, 1893.

Electric Time Signaling System and Apparatus, W. A. Purcell, Newark, N. J., 523,023. Filed Nov. 16, 1893.

Electric Burglar Alarm, A. Stromberg, Chicago, Ill. Re-issued. 11,423. Filed Oct. 4, 1892.

Conductors, Conduits and Insulators:—

Automatic Safety Joint for Electric Wires, J. H. Curry, Wilkensburg, Pa., 521,908. Filed Nov. 22, 1893.

Has for its object to automatically cut out and render harmless a section trolley wire when a break occurs.

Insulator, J. M. Anderson, Boston, Mass., 522,175. Filed Mch. 22, 1894.

An insulator having a metallic crown forming a slot for the reception of the wire and means for holding the latter in place.

Distribution:—

Transformer Electric Lighting System, P. Wright, Philadelphia, Pa., 521,594. Filed Dec. 9, 1893.

Employs positively driven mechanism released by electro-magnetic devices in the local circuit and adapted to make and break the local primary circuits; automatic means for stopping said mechanism and a switch for controlling the secondary and local circuit.

Transformer System of Electrical Distribution, P. Wright, Philadelphia, Pa., 521,925. Filed Jan. 3, 1894.

The system comprises several transformers and a switch responding to changes in current and adapted to automatically interrupt the secondary circuit before the primary, and to close the primary circuit before the secondary.

Dynamos and Motors:—

Electric Motor, J. Lee, Brooklyn, N. Y., 521,799. Filed Aug. 2, 1893.

Employs a frame supporting the field magnets and enclosing the brushes, and a speed regulator intermediate between the armature and field magnets.

Brush Holder for Dynamo Electric Machines, R. Fuller, Detroit, Mich., 523,051. Filed Mch. 19, 1894.

A holder especially adapted for carbon brushes and having a spiral spring exerting a constant pressure upon the carbon block.

Commutator, J. C. Pyfe, Chicago, Ill., 523,053. Filed April 14, 1894.

Relates especially to means for readily assembling the commutator segments and replacing any one without interfering with the others.

Dynamo or Magneto Electric Machine, L. Paget, New York, 522,063. Filed June 20, 1893.

A magneto electric machine having a rotary part with projecting pole pieces and a stationary part with corresponding projecting pole pieces, and a single coil wound about the stationary part.

Galvanic and Thermo-Electric Batteries:—

Voltaic Cell, H. Timm, New York, 522,127. Filed Apl. 19, 1894.

Consists of a voltaic couple formed of a dry layer of a soluble electrolyte inclosed between two layers of an absorbent material and two metallic plates.

Lamps and Appurtenances:—

Electric Arc Lamp, S. P. Johnson, Schenectady, N. Y., 521,798. Filed Dec. 20, 1893.

Relates to certain details of mechanical construction in the feeding mechanism.

Electric Arc Lamp, W. J. Davy, London, Eng., 521,877. Filed Apl. 14, 1894.

Relates especially to mechanism for keeping a constant arc in a focusing lamp by means of a gravity friction grip device acting on the cord and regulated by series and shunt solenoids.

Electric Arc Lamp, L. B. Marks, New York, 521,936. Filed Mch. 30, 1894.

Claim 1 follows:

An arc lamp having the arc surrounded by a transparent or translucent inclosure provided with a passage for the egress of gases developed by the arc, and a gas check formed by a body of gas in said passage to decrease the entrance of air to the inclosure.

Adjustable Carrier for Electric Lamps, R. Faries, Decatur, Ill., 521,932. Filed Feb. 23, 1894.

Metal Working:—

Electric Soldering Tool, J. F. McLaughlin, Philadelphia, Pa., 521,914. Filed May 19, 1893.

Method of Heating Metals Electrically, C. L. Coffin, Detroit, Mich., 522,151. Filed Nov. 16, 1893.

Invention consists in heating the metal, connecting it with one terminal of the generator, bringing it into contact with a liquid electrode connected with the other terminal of the generator, and establishing an arc between the two electrodes.

Miscellaneous:—

Sound Conducting Apparatus, G. A. Leech, New York, 521,800. Filed Aug. 19, 1893.

An electro-medical apparatus for the treatment of deafness.

Electric Lamp Lighter, J. F. McLaughlin, Philadelphia, Pa., 521,809. Filed March 22, 1893.

Magnetic Separator, H. Carmichael, Malden, Mass., 521,906. Filed Nov. 20, 1893.

Thickness Gauge for Paper Making Machines, O. W. T. Am Ende, Bad Harzburg, Germany, 521,976. Filed Nov. 10, 1893.

Process of Manufacturing Metallic Powder, J. Sachs & E. Huber, New York, 521,991. Filed Feb. 12, 1894.

Process consists of interposing between electrodes during electrolysis a metallic conductor in a finely divided state.

Electrically Operated Adding Machine, R. Baumann, St. Louis, Mo., 522,097. Filed Sept. 4, 1893.

Electrically Operated Register, S. J. Glass, Milwaukee, Wis., 522,113. Filed Oct. 23, 1891.

Railways and Appliances:—

Conduit Electric Railway, C. J. Reed, Orange, N. J., 521,801. Filed Apl. 14, 1893.

Claim 1 follows:—

A pair of electrical conductors crossing each other at stated intervals and connected to the opposite poles of an electrical generator, in combination with a slitted conduit; the successive sections of the overlapping conductors lying in alignment with the slit of the conduit.

Conduit Electric Railway, C. J. Reed, Orange, N. J., 521,802. Filed Feb. 13, 1893.

Employs a system of sectional conductors within a conduit and normally out of circuit except during the passage of the cars.

Trolley Stand, E. F. A. Hastings, Avalon, Pa., 522,057. Filed Apl. 12, 1894.

Means for Suspending Electric Motors from Cars, R. Lundell, Brooklyn, N. Y., 522,067. Filed Sept. 4, 1893.

Employs a reducing gearing of sprocket wheels and chains and a sliding support for the motor with means for compensating for undue stretching of the chains.

Trolley Wire Hanger, T. J. McTighe, New York, 522,180. Filed Jan. 23, 1893.

Switches and Cut-Outs:—

Push Button, J. F. McLaughlin, Philadelphia, Pa., 521,808. Filed March 22, 1893.

Rheostat, B. E. Baker, Bridgeport, Conn., 521,843. Filed Nov. 27, 1893.

A rheostat, the cores and resistance wires of which are imbedded in a block of plastic material.

Controller for Alternating Current Machines, E. B. V. Seaverns, 521,867. Filed March 29, 1893.

Consists of a switch or circuit controller included in a field winding traversed by a continuous current.

Circuit Maker, D. F. Hall, Schenectady, N. Y., 522,035. Filed Oct. 16, 1893.

Claim 1 follows:

A circuit maker comprising a bracket, a supporting arm pivoted thereto, a battery receptacle having circuit wires secured thereto and in which receptacle the elements forming the battery are held normally apart and adapted to coalesce when the receptacle is inverted.

THE MUNICIPAL LIGHTING PLANT, MARBLEHEAD, MASS.

WORK has begun on the new station for the Marblehead municipal electric light service. The building, which is to be of brick, with granite trimmings, will be of the following dimensions: The main building, 64x55 feet, with pitch roof, iron trusses and slated walls to be 19 feet high. The engine and dynamos will be located in this room, the floor of which will be concreted. The boiler house is on one of the L's to the main building, and will be 29x46 feet, with monitor roof. On the other end of the building will be situated the office and store rooms, which will be 18 feet 4 inches by 52 feet 4 inches. The entire length of the building will be 111 feet. The chimney will be 110 feet high, with a four-foot flue. The engines are to be built by the Rice Sargent Engine Company of Providence, R. I., and will be of the Corliss type, cross compound condensing engines for high and low pressure, 200 horsepower, which will be used for the arc lights. The low pressure engine will have 4 cylinder 26 inches and 14 inches for high pressure with 36-inch stroke, with a driving wheel 12 feet in diameter, weighing 20,000 pounds. The engine will be fitted with all the modern appliances. There will also be an auxiliary engine of 100 horse power, which will be used for running the incandescent lights. The boilers are to be built by the Atlantic Works, East Boston. There will be two, 17 feet long, 72 inches in diameter, horizontal, tubular, of 125 horse power each, to be of steel.

The Western Electric Company of New York was given the contract for the dynamos, wire system and all the electric apparatus. The plan of wiring and lamps will cover very thoroughly all parts of the town. It is a mixed system of 105 arc and 129 25-candle-power incandescent lamps.

The building is to be completed by Aug. 15th, and the engines are to be put up and running by Sept. 20, and it is proposed by the committee to have the plant all ready to start up by Oct. 15th.

ELECTRIC LIGHTING IN BALTIMORE.

THE city lighting in Baltimore has now been divided between the Maryland Electric Co. and the old Brush Electric Co., the latter getting the eastern district and the former securing the western. The price is 35 cents a night per lamp. The city will gain nothing financially by the new contract, as the cost is the same as is now paid, but the contract is more specific than the present one and is expected to secure satisfactory lighting. The companies must maintain a patrol system by which every lamp will be examined three times in a night, and reports of unlit or defective lamps must be made to the general superintendent of lamps daily. Every lamp must be of 2,000 c. p., and the general superintendent is authorized to test the service at any time. Lamps must burn from sunset to a half hour before sunrise. If a lamp is out for a half hour in that period and burns the remainder of the night, the contractor will be subject to a forfeiture of half pay for it. If the lamp is out an hour no pay will be allowed.

LOUISVILLE ARC LIGHT GLOBES NOT TO BE PAINTED.

The Board of Public Works has made an order requiring the Louisville Electric Light Company to refrain from painting or in any way obscuring electric light lamps paid for by the city of Louisville. In some localities, at the request of property-owners, the Electric Light Company has prevented the light from penetrating into private dwellings by painting spots on the globes. Hereafter this will not be permitted, and all of the globes will be permitted to give out a full light, no matter how much it may inconvenience individual property-owners.

Trade Notes and Novelties AND MECHANICAL DEPARTMENT.

MR. HENRY B. OAKMAN.



Mr. Henry B. Oakman.

THE electrical trade generally will be interested in the announcement that Mr. Henry B. Oakman has become the General Eastern Agent of the Wenstrom Electric Co., with headquarters at 136 Liberty street. Mr. Oakman is still a very young man—barely thirty—but he has been through the whole active development of modern electrical work. His career began in the office of the old Electrical Supply Co., in Dey street, where he was able to gratify his taste for electrical matters. His promotion was rapid and he soon became head salesman.

This position he resigned in 1891, to connect himself with the Edison General Electric Co., in this city. He was then put in charge of the agency for the New England business at New Haven, and was afterwards transferred to Buffalo, to represent the Edison interests in Northern and Western New York. At Buffalo he opened large and handsome headquarters, visited by many of our readers during the Buffalo Street Railway Convention, and well known to all electricians in the northern part of this State. While holding this position Mr. Oakman made some of the largest sales of apparatus recorded by the Edison interests in that territory; but the consolidation effected at that time with the Thomson-Houston interests soon induced him to resign and seek fields of better opportunity. Believing in the merits of the Wenstrom machines he took up their sale, with great success, and now is in charge of the general eastern agency, as stated. Mr. Oakman has great advantage in his long familiarity with the electrical field and apparatus, and in his new sphere of work can count confidently on the support and encouragement of a host of friends. His list of recent sales of dynamos and motors is a long one.

SALES BY THE CHARLES E. GREGORY CO.

THE CHAS. E. GREGORY CO., Chicago, Ill., report the following sales for June: One 50 lt. D. 12 T. H. arc dynamo to P. Norcross, Janesville, Wis.; two 30 lt. and one 20 lt. Sperry dynamo to B. Marks & Son, Chicago; one 6 lt. Sperry arc dynamo to Jas. I. Ayer, New York, N. Y.; one 8 lt. Excelsior arc dynamo to J. P. Karr, Reynolds, Ind.; one 500 lt. 1,000 volt alternator to P. Milroy, Hopkinton, Ia.; two 180 amp. Westinghouse generators to International & Wells Pkg. Co.; one 180 amp. Westinghouse generator to W. T. Osborne & Co., Kansas City; one 210 lt. Edison generator to Geo. B. Weise & Sons, Chicago; one 25 H. P. D. R. Westinghouse motor to O. H. Parker, Anniston, Ala.; three 3 H. P. Westinghouse motors to Andrews and Johnson, Chicago; one 5 H. P. T. H. motor to Andrews and Johnson, Chicago; one 2 H. P. Sperry series motor to John Raber, Chicago; one 8 K. W. Edison motor to M. Schu, Aurora, Ill.; one 3 K. W. Edison motor to Chicago Braid and Embroidery Co., Chicago; one 1 H. P. Crocker-Wheeler motor to Four Lakes L. & P. Co., Madison, Wis.; one 1 H. P. C. & C. 110 volt motor to A. L. Daniels, Marion, Ia.; one 1 H. P. Jenny motor to W. J. Davis, Aurora, Ill.; one 1 H. P. Rockford motor to Geo. Wolff, Chicago; one 1 H. P. Detroit motor to Baltimore Cafe, Chicago; one 1 H. P. Crocker-Wheeler to Lyon & Healy, Chicago; one 1 H. P. Edison to Goltz & Sinclair, Milwaukee, Wis.; fourteen Edison arc lamps to W. T. Osborn & Co., Kansas City, Mo.; six Knowles D. C. arc lamps to Kuh, Nathan & Fischer, Chicago; six Edison arc lamps to B. F. Harris, Jr., Champaign, Ill.; fifteen Edison arc lamps to M. Eichburg, Chicago; and a total sale of 147 fan motors of all kinds. Mr. Gregory reports that the demand for apparatus is far in excess of

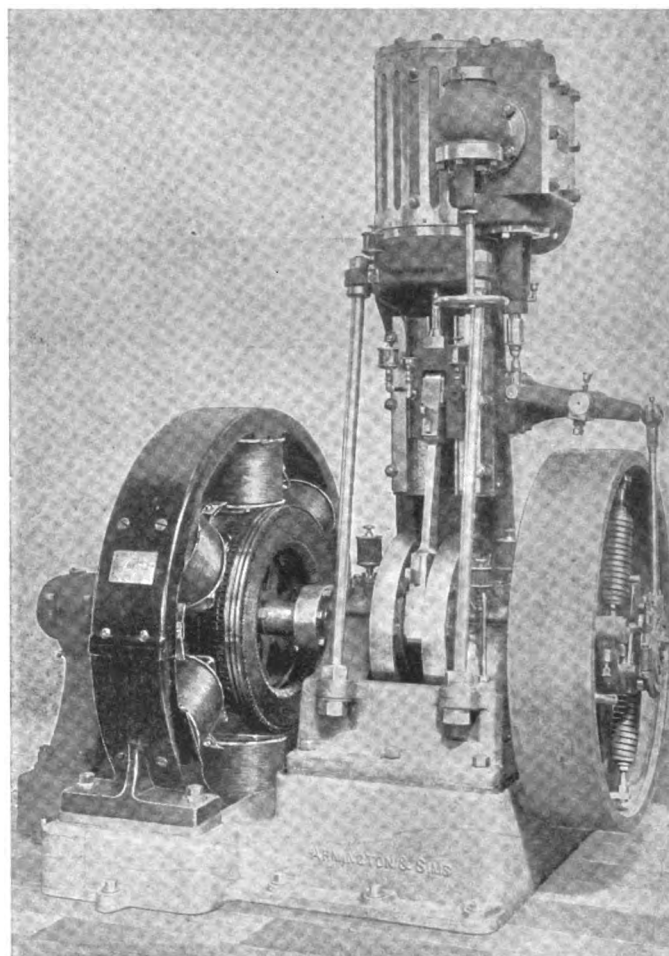
the supply, and that purchases of dynamos and motors were made in Boston, San Francisco and Philadelphia during the month for their stock.

A POINTER FOR ELECTRIC STREET RAILWAYS.

THE Packard Mogul Lamp seems to have found still another field of usefulness—this time in connection with electric railway work. It has come to be quite the proper thing for the enterprising electric street railway company to furnish some kind of summer attraction at some point along its line and thus increase the passenger traffic. The point selected is usually a park, if such a place is available, and special attractions such as concerts and extra illuminations are furnished. It is here that the Packard mogul lamp is available, and a large number of roads are already using them for just this work. Special illumination of the park is advertised for certain evenings in the week, and the companies are reported to be netting a handsome profit from a largely increased business. The Mogul lamp is particularly adapted for this work, as the cost of installing is very slight compared with arc lamps, whereas the result is fully as effective; and an incandescent lamp of so large a size, being a comparatively new thing, is an attraction in itself. The lamps as generally used are burned four or five in series direct from the railway circuit, and can thus be operated at a comparatively slight expense. The Electric Appliance Company have supplied a number of such outfits and will be pleased to furnish information or submit estimates.

GENERAL ELECTRIC LIGHTING UNIT IN MANHATTAN LIFE BUILDING, N. Y.

Our illustration shows one of the four compact plants which the General Electric Company has recently installed in the Man-



GENERAL ELECTRIC LIGHTING UNIT IN MANHATTAN LIFE BUILDING, N. Y.

hattan Life Insurance Building, New York. It consists of a six-pole 25 kilowatt 800 revolution iron clad generator, connected to the shaft of an Armington & Sims vertical 40 H. P. $9\frac{1}{2}$ x 10 inch engine. The other three consist of 50 K. W. generators and 80 H. P. engines. These small direct connected generating sets are now, it is said, being built in large numbers by the General Electric Company at its Schenectady Works, the demand for them having become urgent.

IRON ARMORED INSULATING CONDUIT.

Few improvements have elicited warmer commendation in the field of electric wiring than the recent addition of iron armored insulating conduit to its long list of apparatus, by the Interior Conduit and Insulation Co. The Interior Conduit system has from the first enjoyed a unique reputation for its flexibility, but it has now included among its materials those which are not only flexible but practically indestructible and imperishable. The

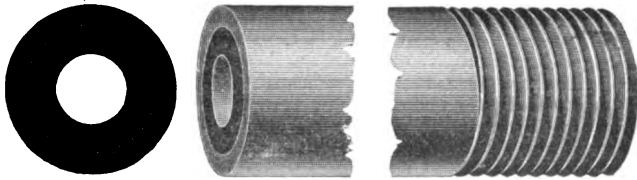


FIG. 1.

notable tendency in architecture of late years has been towards larger proportions and the use of the most substantial materials obtainable; and in keeping with the new steel internal structure, the iron conduit is found of the utmost utility and value, and electric wiring, whether in the main conductors or the smallest branches, has been brought to a remarkable degree of perfection.

The insulating iron-armored conduit consists of plain insulating tubing placed within a heavy wall of lap-seamed, wrought iron pipe, which thus furnishes a perfect armor $\frac{1}{2}$ inch in thickness. The intimacy of the union between the inner tube and its iron wall is remarkable; they are in fact so firmly consolidated and welded together that one seems to be a part of the other. The flexibility of the system is maintained by the use of iron armored insulating junction boxes, elbows, coup-

The accompanying illustrations show some of the features of the iron armored insulating conduit. Fig. 1 shows the actual size

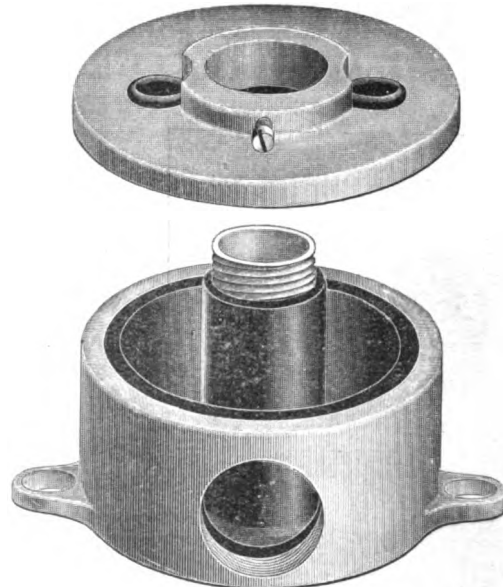


FIG. 5.

of $\frac{3}{8}$ in. (inside diameter) iron conduit. The threads are all straight, so that the ends of the lengths, etc., shall abut in the centre of the coupling, thus maintaining a continuous insulation.

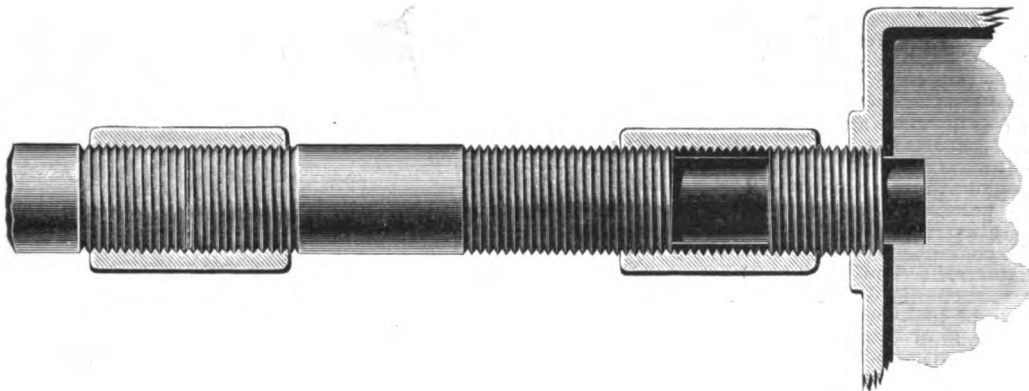


FIG. 2.



FIG. 6.



FIG. 8.

lings, etc. This conduit possesses all the qualities of gas or water pipe, and by means of the tools furnished for cutting, threading, etc., can, it is claimed, be installed with equal ease. It is at once so simple and durable that it can be used under concrete, tiled or mosaic floors, etc., without the pre-

Fig. 2 shows the application of a continuous insulating nipple to a junction box and illustrates how the continuity of the insulation of the system can be maintained, if the tube should be too short

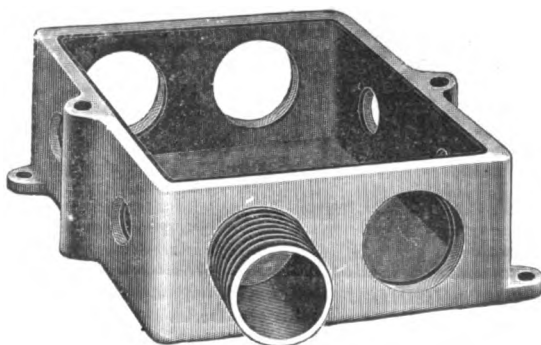


FIG. 5.

cautions necessary with plain or brass armored conduit; and at the same time, a saving in labor results from the fact that it can be installed at an early stage in the construction of a new building, without anxiety as to the rough usage it may have to sustain.

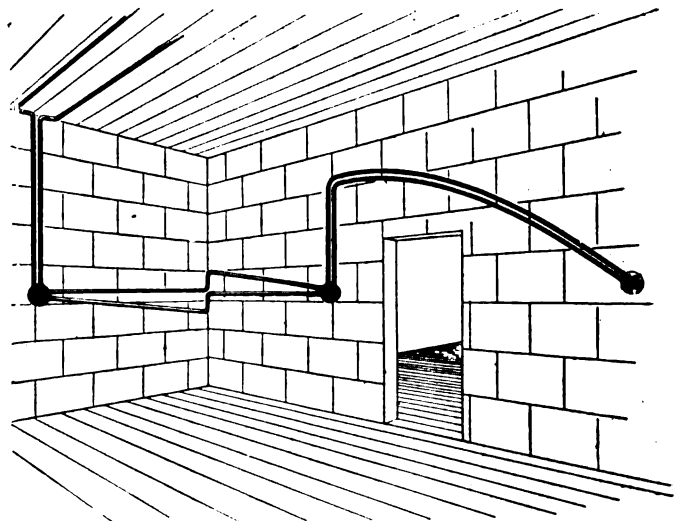


FIG. 7.

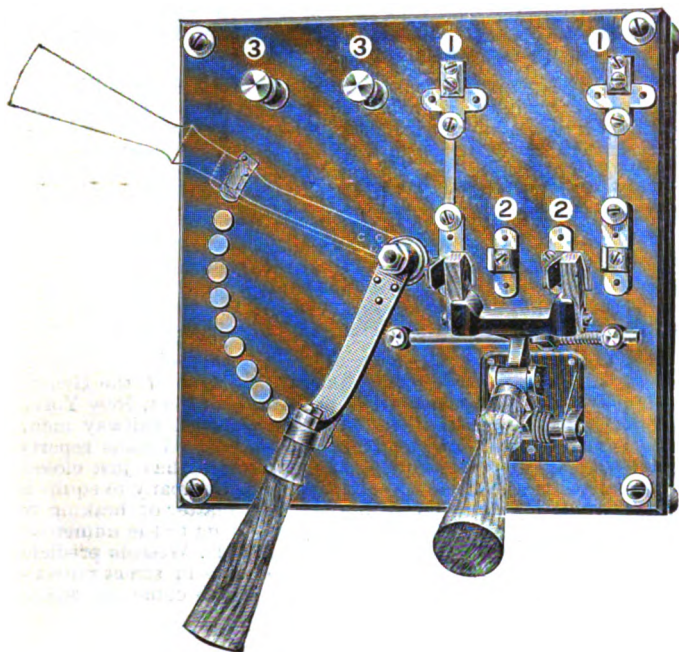
by inaccuracy of measurement. The nipples can also be applied throughout the system to correct slight mismeasurements. Fig. 8 shows an elbow outlet, Fig. 4, a branch box, and Fig. 5 an outlet box. Fig. 6 shows a box nipple. Fig. 7 shows the application of the system.

THE BRISTOL RECORDING RAILWAY VOLTMETER.

THE BRISTOL CO., of Waterbury, Conn., who have met with such great success with their recording voltmeters have already sold several hundred of these instruments to the leading electric light companies in the United States. Among the recent additions to their list of instruments is the new voltmeter for electric railway work with a range of from 450 to 600 volts, and a clock movement which revolves a dial once in 12 hours. This type of instrument was specially designed for the West End Railway Co., of Boston, and the company expect a general demand for this particular voltmeter in railway power stations.

THE HILL SELF LOCKING STARTING SWITCH.

THE accompanying illustration shows a very clever device for protecting the armatures of motors when the current is first thrown on. In installing motors, the switch and rheostat being generally placed side by side, and being entirely separate from each other, it oftentimes happens that through haste or careless



HILL SELF LOCKING STARTING SWITCH.

ness the current is thrown on by the switch before the resistance is cut in by the rheostat, and as a consequence the motor armature is burned out or the fuses blown. To avoid this difficulty the W. S. Hill Electric Co., of Boston, Mass., have placed on the market the self locking starting switch here shown, in which the switch and rheostat are combined in such a manner that the switch cannot be thrown in without first putting in all of the resistance, thus avoiding any possible chance of an accident of this kind.

POWER TRANSMISSION AT MONTREAL.

THE CHAMBLEY MANUFACTURING CO., of Montreal, Can., which controls the water power at the Chambley Rapids of the Richelieu River, is calling for tenders for the erection of a dam and the furnishing of water wheels and electrical machinery for the development of the power and its transmission electrically to Montreal, a distance of about 17 miles in a direct line. The Richelieu River is the outlet of Lake Champlain, and the rapids are four miles long with a total descent of 62 feet. The surroundings are favorable for the erection of dams, as the banks of the river are high and its bed is rock. To utilize the power fully, a series of dams would have to be built across the river at the rapids, but at present it is proposed to erect one only, which, according to the calculations of the engineers who have been consulted, would give a head of from 26 to 27 ft. and yield about 27,000 h. p. at low water. For the present, the delivery of about 15,000 h. p. in Montreal is contemplated, of which some 3,000 h. p. would be used for arc lighting, 6,000 h. p. for incandescent lighting and 6,000 h. p. for motor power.

DOUBLE RUBBER CORE WIRE.

The General Electric Company, mindful of the necessity of perfecting the wire it manufactures as the exigencies of electrical practice become more exacting, has placed upon the market a new rubber covered wire, which is claimed to be superior to anything of the kind yet offered. This is known as the Double Rubber Core wire. It has three coverings. Next to the wire is an inner core of soft rubber, free from sulphur and protected by a second heavy covering of pure vulcanized rubber. Over this is a braided sheath, finished with a weatherproof compound which serves to protect the rubber from the attacks of acids and alkalis and from mechanical injury. Before applying the first covering the copper wire is thoroughly tinned to guard it from corrosion. The rubber coverings are made of the best grade of fine Para rubber. The wire is made with three standard thicknesses of insulation. The lightest is intended for ordinary electric light wiring and for use on circuits not exceeding 500 volts. The second for use on circuits not exceeding 2,000 volts, such a street railway, primary circuit alternating and arc light circuits up to 40 lamps. The thickest insulation is for circuits up to 5,000 volts and is devised for high tension work. Wire with the last two insulations may be armored for any class of submarine work.

BARRIETT ELECTRIC MOTOR & DYNAMO CO.

The above company since establishing its works at 161 Washington street, New York city, has been very busy supplying its motors, and running a department in which it undertakes to effect repairs of all kinds of dynamo-electric machinery. Mr. Barriett has a large number of testimonials as to the high quality of his work. For example, the Worthington pump people write:—"The electric motor which you put in for us about two years ago for running the elevator between our basement and sidewalk has been in almost constant operation and is still doing good service, at very insignificant cost for repairs." The Prentiss Tool and Supply Co., New York, write in similar terms as to two 2 h. p. Barriett motors they have had for three years; also Gov. Flower's firm, New York, and many others. Mr. Barriett's motors are well built, stand hard work, and are reasonable in price. All the work in the shops is done under his personal supervision.

THE PERKINS THREE WIRE SWITCH.

The increasing popularity of the Edison three wire system, and the scarcity of efficient and satisfactory circuit breakers especially adapted to it, has led the Perkins Electric Switch Mfg. Co., of Hartford, Conn., to produce the "Gibbs three-wire switch." This is a neat and simple device, designed especially to meet the latest requirements of the Board of Fire Underwriters, and is made to break the circuit of each one of the three wires simultaneously in two places. It is well made, in the well known workmanlike style of the Perkins company, and is said to be meeting with great success everywhere.

WESTINGHOUSE ACTIVITY.

THE Boston Traveller says: The business of the Westinghouse Electric Company is still making a steady gain. Its manufacturing output footed up, last month, about \$350,000, and orders were received for about the same amount of new apparatus. The company is now turning out about 4,000 lamps per day, as its new glass works are a success. It has bought 14 acres of additional land at Brinton, making 37 acres, for its new works. The additional land is for the construction of two other buildings; one for a blacksmith shop and one for an establishment to cut or punch out the laminated iron for electric converters, armatures, etc. The company is planning for a big business during the coming season.

ANOTHER ELECTRIC COMPANY FOR NEW JERSEY.

A movement is on foot in Bloomfield, N. J., for the organization of a local water, light and power company. The capital stock is to be \$50,000, with shares of \$10 each. It is the intention of promoters of the enterprise to make it an entirely local institution, and sell all the shares to residents of the town. About 200 shares have thus far been subscribed.

EDISON EXTENSIONS AT ALTOONA, PA.

THE EDISON ELECTRIC ILLUMINATING COMPANY, of Altoona, has decided to remove its two plants from their present locations. The new location was not secured until recently, when negotiations were closed for the property on Union avenue, now occupied by a coal wharf. It is the intention of the company to move without a single stop in the service. The new building is to be fireproof and in the latest and best style of electrical engineering.

OHIO BRASS CO.

The Ohio Brass Company, of Mansfield, Ohio, are now making a new design of the Westinghouse type of trolley wheel in which oil is used as a lubricant for the steel spindle in addition to the graphite bushing. The centre of the hub of the wheel is hollowed out around the graphite bushing and the recess filled with felt packing. Holes are provided so that the felt may be kept saturated with oil which in turn feeds through the graphite bushing on to the spindle, keeping the graphite moist and lubricating the bearing thoroughly. They say that this adds about 25 per cent. to the life of the wheel. It is advisable that a few drops of oil be poured into the oil well every few days. These wheels are made of extra hard quality bronze metal and proportioned so as to give the longest possible wear. They are balanced and turned and in consequence will run smoothly on the trolley wire.

"THE MINERAL INDUSTRY FOR 1893."

OUR esteemed contemporary, the *Engineering & Mining Journal*, has just issued for 1893, its annual volume on "The Mineral Industry." Some idea of its vast scope may be formed from the fact that there are 9,000 separate titles in the index. It is, indeed, a superb and invaluable book, the best thing of the kind ever done, government reports not excepted. The publishers are entitled to the highest praise for giving us that which is at once an encyclopaedia, a statistical annual, and a market record.

NEW STATION FOR FLATBUSH GAS CO.

The new electric light station for the Flatbush Gas Company, at Flatbush, N. Y., will be 60 ft. wide and 73 ft. long, divided into a dynamo room and boiler house. The roof of the building will be furnished by The Berlin Iron Bridge Co., and covered with their patent anti-condensation corrugated iron roof covering.

EDISON NEW YORK EARNINGS.

The subjoined is a very encouraging statement of comparative earnings, for May, issued by Mr. J. Williams, treasurer of the Edison Electric Illuminating Co., of New York:—

	May, 1894.	1893.	
Gross	98,344.95	93,185.08	5,159.87 Inc.
Net	46,864.98	37,887.25	9,477.68 Inc.
Five Months.			
Gross	586,408.85	524,243.98	62,159.87 Inc.
Net	323,140.48	248,104.89	75,035.59 Inc.

ELECTRICITY ON STATEN ISLAND.

It is stated that the electric power property on Staten Island, in which Mr. Erastus Wiman was so deeply involved, is doing well in the hands of Mr. F. S. Gannon, the receiver, and that a clear profit of \$26,000 was made the last year.

WESTERN NOTES.

ACME FAN MOTORS for direct current are being extensively sold by the Electric Appliance Co.

THE HARRISON INTERNATIONAL TELEPHONE COMPANY has decreased its capital stock from 80 millions to 40 million dollars.

THE FREEPORT ELECTRIC COMPANY, Freeport, Ill., has been incorporated by Robert S. Brown, J. B. Taylor and George H. Currie. The capital stock is \$150,000.

THE ROGERS PARK LIGHTING COMPANY, Chicago, has been incorporated with a capital stock of \$80,000. The incorporators are Henry Wiestand, Geo. N. Stone and Lloyd S. Kirkland.

THE BLUFF CITY ELECTRIC STREET RAILWAY COMPANY has been incorporated at Waukegan, Ill., with a capital stock of \$200,000, by Dewitt L. Jones, S. D. Talcott and Charles Whitney.

THE MUTUAL ELECTRIC LIGHT AND POWER COMPANY, Chicago, has asked the Circuit Court to issue an injunction restraining the city from interfering with its lines of wires strung on the poles of the Chicago City Railway Company. An injunction against the Hyde Park Electric Light and Power Company, restraining it from refusing to furnish current, is also asked.

ABENDROTH & ROOT MANUFACTURING COMPANY, manufacturers of the well-known Root water tube boiler, have found it necessary to open a western office in order to take better care of their growing western business. Their Mr. George K. Hooper, in charge of the Rochester office for two years, has been appointed western manager with offices at 1423 Monadnock, Chicago. Mr. Hooper reports the outlook for business as very encouraging.

THE ST. LOUIS RAILWAY COMPANY, of St. Louis, Mo., have placed the order for their new car barn with the Berlin Iron Bridge Co. The building will be 64 feet in width and 185 feet in length, with brick walls, the roof being of iron covered with the Berlin patent anti-condensation corrugated iron roof covering. It is the intention of the railroad company to make this station absolutely fire-proof and thereby save insurance. There will be no woodwork used in the construction of the building and it will not be necessary to carry any insurance whatever.

THE ELECTRIC APPLIANCE COMPANY are placing upon the market a complete magneto telephone system for private lines and office and factory exchanges. The principal feature of the system is their "Acme" magneto telephone which, they say, is certainly a winner in the magneto telephone line. They are at work upon a complete catalogue of their system which they hope to have ready for distribution in a few weeks. Any applications for copies will be gladly placed on file until that time. The warm weather of the past week has started a boom in the fan motor business and the Electric Appliance Company are busy filling orders for the Weston alternating current fan motor for which they are Western agents and of which they carry a large stock in Chicago.

NEW YORK NOTES.

MR. W. V. POWELL, of Archita, has been elected grand chief telegrapher of the Order of Railway Telegraphers.

MR. R. T. LOZIER has resigned his position with the General Electric Co. at Schenectady and returned to New York, where he will soon engage in business for himself.

MR. R. T. McDONALD, president of the Fort Wayne Electric Corporation was in this city last week, when he spoke most hopefully of the situation, and reported a large amount of new business. In fact he regards it as likely that within a year, the Fort Wayne Co. will be doing as large a business as any other concern now competing in the electrical field, with apparatus for electric light and power.

THE E. G. BERNARD CO. has succeeded the Adams Electric Co. of Worcester, Mass., and will continue their business, making a specialty of wrought iron dynamos and motors up to 10 K. W. both belted and direct connected. Mr. A. D. Adams goes with the Bernard Co. and will have charge of this department.

MR. E. J. WESSELS, formerly of the Short Electric Railway Company, has been appointed General Manager of the Genett Air-Brake Company, with offices at 38 Wall street, New York. These offices are conveniently located for street railway men, being in the heart of the financial district. Mr. Wessels reports business as being very promising. The company has just closed a contract with the New Orleans Traction Company to equip a number of its cars with its air-brake. The matter of braking is receiving unusual attention at this time, owing to the numerous accidents which have recently occurred. Mr. Wessels predicts that the Genett Air-Brake is destined to become in street railway practice what the Westinghouse brake has become on steam roads.

CANADIAN NOTES.

SYDNEY, C. B.—A consolidation has been effected between the Sydney Gas and Electric Light Company and the Edison Electric Light and Power Co., Ltd. The capital stock will be \$35,000, and an issue of \$15,000 of bonds will pay the debts of the company and provide money for improvements. The company has the contract for lighting the Sydney Hotel with 268 lights. The Post Office and I. C. R. Station are asking for lights.

M. D. BARR & CO., TORONTO, CAN.—The above firm have just issued a circular to the trade announcing their establishment as dealers in electrical supplies of every description for lighting, power and railway work. They have already secured the agency for a variety of American standard apparatus and are prepared to bid for complete electric lighting plants and street railway station and car equipments. Mr. M. D. Barr is well-known to the Canadian electrical trade, having been for nearly five years past been manager of the Edison interests in Canada. The offices of the Company are located at 56½ King St., Toronto, Can.

THE VIADUCT MANUFACTURING Co. of Relay, near Baltimore, one of the oldest electrical concerns, was struck by lightning last week and destroyed by the fire that broke out immediately after. All that was saved was a few telephone boxes. The company has a capital stock of \$500,000, and the veteran, Mr. A. G. Davis, is president. The loss is placed at \$50,000, the insurance at \$35,000. About 200 people were employed.

Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE Electrical Engineer.

Vol. XVIII.

JULY 18, 1894.

No. 324.

LOCATING FAULTS AND CROSSES.

BY

Samuel C. Heile.

PERHAPS the following modifications of Dr. Frölich's method of locating faults and crosses may be new to some of your readers. I have used both methods at intervals during the past year and find it easy to locate either a cross or a fault within a distance equal to about two per cent. of the length of the conductor.

LOCATION AND MEASUREMENT OF A FAULT WITH AN E. M. F. IN THE CIRCUIT.

Let G , Fig. 1, be a galvanometer whose deflections are proportional to the currents passing through it; preferably a voltmeter.

Let A be any good ammeter.

Let i = current in main circuit.

" E_1 = counter E. M. F. of motor [variable].

" r = resistance of voltmeter [or galvanometer].

" R = total resistance of line.

" X = resistance of line to fault.

" F = resistance of fault.

" V_1 = reading of voltmeter or galvanometer when connected to a and b .

First.—Take reading between a and b , and call this V_1 . Then read between a and earth, and b and earth and call the reading which is the *larger* of the two V_2 , and that which is the *smaller* V_3 . The fault will be on the side having the smallest reading.

To obtain the resistance of the fault the common formula is applicable

$$F = r \left[\frac{V_2}{V_1} - 1 \right].$$

To obtain X we may write, paying no attention to signs of V_2 and V_3 :

$$X = \frac{V_1 V_2}{i [V_1 + V_2]}, \text{ which can be readily proved.}$$

LOCATION OF A CROSS BY AMMETER AND VOLTMETER.

Place at R , Fig. 2, a resistance large enough to cut the current down to some safe value giving a good deflection

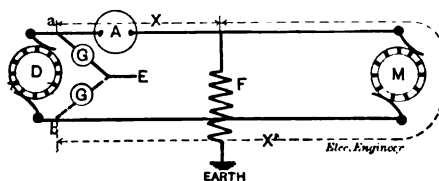


FIG. 1.

on the ammeter A . Connect the voltmeter at any points a and b outside this resistance. Let a and b be two convenient points on the line. Let R = resistance of line.

1st. Connect a and b and read ammeter and voltmeter and call readings i_1 and V_1 .

2d. Break circuit at a and at b and read again and call readings i_2 and V_2 . Thus the resistance of cross

$$= F = \frac{V_2 - 2 i_2 X}{i_1}$$

$$\text{And } X = \frac{1}{2} \left[\sqrt{\left(\frac{V_2}{i_2} - \frac{V_1}{i_1} \right) \left(R - \frac{V_1}{i_1} \right)} - \frac{V_1}{i_1} \right]$$

This method of locating a cross is very rapid and in locations where there is telephonic connection between the power station and the motor or place where the power is

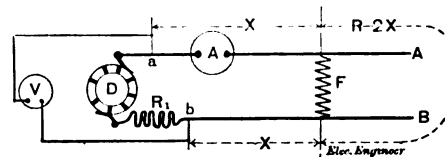


FIG. 2.

used the whole operation would not last ten minutes. The motor being first short circuited and then the circuit broken at the same point as the engineer at the generating station telephoned his instructions.

As the ordinary station instruments may be used in either case and in the location of a cross without any change in their connections or without removing them from the switchboard, the method I think has some advantages.

FREEMAN'S NEW DIRECT CURRENT MOTOR AND GENERATOR.

DURING the past two years Mr. Walter K. Freeman, whose work in alternating current apparatus is well known, has devoted his energies to perfecting new designs for direct and alternating current apparatus, more especially the armored type of consequent pole, multipolar generators and motors; and the illustrations, Figs. 1 and 2, show the general aspect of these machines designed for direct current. In general form the machines consist essentially of a base, provided with integral flanges between which are located the wound fields, hinged at the bottom and secured in place by bolts; the bearings for the armature shaft resting on the bed-plate, making altogether an elegant, compact and simple piece of electrical machinery.

Within the body of the field construction are four pole-pieces. Two are wound with the necessary amount of wire to develop the required magnetic field, and the other two consequent poles are created by the mutual action of the wound fields. The armature is so made that the closest proximity exists between it and the poles, without touching. The air gap being shortened to the greatest possible degree so as to secure the highest magnetic and electric efficiency.

The surfaces of the armature being perfectly smooth, with the conductors threaded through the laminated core, gives that portion of the machine a very substantial advantage over the ordinary dynamo and permits, among other things, the handling of the armature without fear of injury, and also dispenses with the use of the binders or bands to

hold the conductors in place. It also allows the armature to revolve very close to the fields, which secures an easy path for the lines of force.

In Mr. Freeman's new iron-clad generator there are several novel features. The peculiar construction of the portion of the magnetic union that completes the fields and

STORAGE BATTERY OF THE ELECTRIC POWER STORAGE CO.

THE efforts which have been made to improve the original Faure battery have given rise to a variety of types, but there are still not a few persons whose opinion is en-

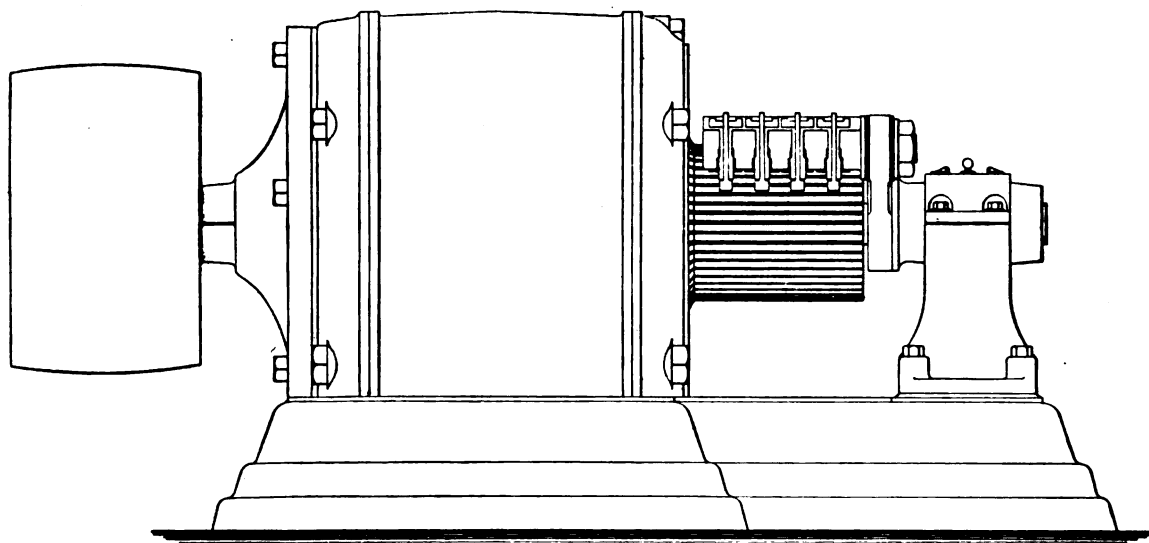


FIG. 1.—THE FREEMAN IRON-CLAD GENERATOR AND MOTOR.

base permits an examination of the field coils and the armature quickly at any time; the wound fields are hinged at the bottom near the bed of the machine, on a line that allows the pole-pieces to swing outwardly without touching the armature. By this simple arrangement it is possible to examine the coils and put on new ones without taking the machine apart. In these machines the inventor has reduced the air gap between the armature and fields to such a degree as to allow the machine to run at an extremely low speed.

Notwithstanding the fact that these generators operate efficiently at a very low speed, the weight per k.w. is no greater than in other types. Generators of this type are

titled to consideration, who believe that the Planté method, or a modification of it, is the correct principle upon which to construct storage batteries. The weak points in the original Planté type of cell are well-known and it was to overcome these and to increase the capacity as well as the life of the cell that the Electric Power Storage Co., of New York, some time ago undertook a series of experiments carried out by Dr. Leonard Paget. In order to obtain a large surface for the action of the electrolyte a construction was adopted, as shown in Fig. 1, which represents a section of a plate with the upper connecting strip and connection plug; while Fig. 2 shows the cell complete and the manner of connecting the plates.

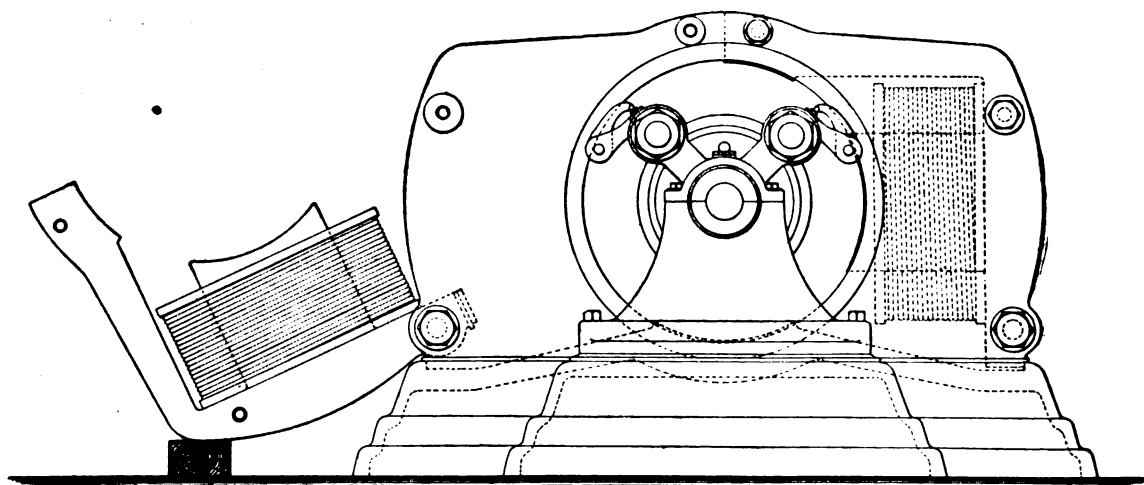


FIG. 2.—THE FREEMAN IRON-CLAD GENERATOR AND MOTOR.

now being made from 1 to 150 k.w. in 18 sizes, and motors from $\frac{3}{4}$ H. P. to 175 H. P.

MORE SEARCH LIGHTS FOR NEW YORK WATERS.

In addition to the big Schuckert search light at Sandy Hook, there will soon be another one at Fire Island. It will be a flash light, and is intended as an aid to navigation. Its candle power is estimated at 50,000,000 c. p.

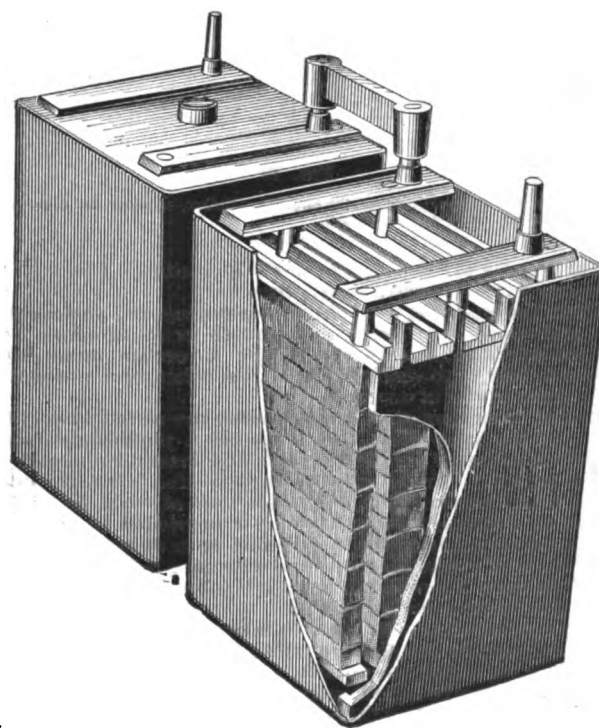
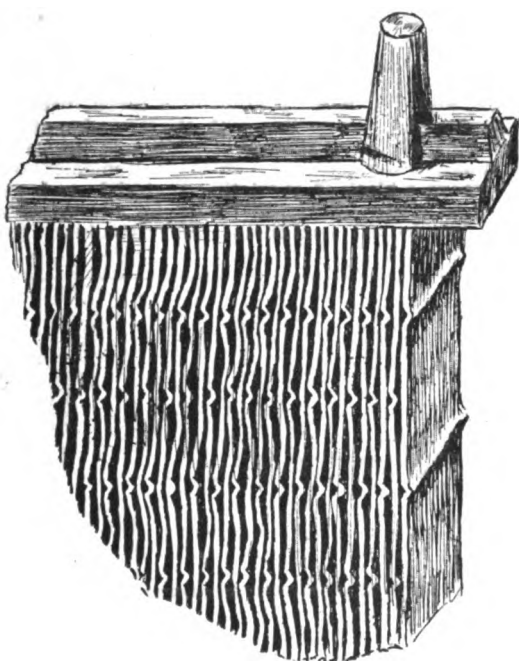
As will be seen, the plates are built up of lead strips held in place at their upper and lower ends by horizontal bars which are cast over the ends of the lead strips, which are dovetailed for that purpose. The original form of the lead strips is a continuous ribbon, $\frac{1}{4}$ of an inch thick, 1 inch wide and weighing 1 pound per square foot. This is run through a machine which cuts it off to the required length and dovetails the ends.

At the same time, the lead ribbon is nicked at intervals

of $\frac{1}{2}$ of an inch, as shown in Fig. 1. When the strips are assembled to form a battery plate these nicks, about $\frac{1}{16}$ inch in depth, form an offset which leaves a space between adjacent strips so as to leave free play for the circulation of the electrolyte.

The initial formation of the lead plates so made up is effected in a bath which converts the lead into lead oxide of lamellar structure, as distinguished from the usual granular form, with the result that it clings closely and intimately to the plate, so that no movement or buckling of the plate causes a dropping off of the active material. The plates are also subjected to a treatment by which it is claimed that the lead cores of the strips remaining after the formation are made impervious to action by the battery electrolyte. Unfortunately, we are prevented from giving the details of this interesting process.

The top of each plate into which the lead strips are cast is made of a composition not attacked by the acid and carries a dowel or taper stud which fits into a corresponding hole in the strip connecting the positive and negative



FIGS. 1 AND 2.—STORAGE BATTERY OF THE ELECTRIC POWER STORAGE CO.

plates of each cell. When the connecting strip is put in place a drop of solder is run into each connecting point and the joints thus made give additional conductivity. Each cell is connected to its neighbor by a connector bar which fits over a similar taper stud on the connecting strip.

320 AMPERE-HOUR CELL.

Discharge Rate.	Unity	80 amps. for 10 h.	100 per cent. capacity.	P. D.
1.46	46	" 6 "	92	" "
1.07	62	" 4 "	88	" "
3.25	105	" 2 "	70	" "
5.08	160	" 1 "	53	" "

6 am.-hrs. per lb. of Pb.

These cells are built in various sizes and capacities from 70 to 5,000 ampere hours and the above table gives the results of a capacity test at different rates of discharge. At the normal rate the cell has a capacity of 6 ampere-hours per pound of lead. The 280 ampere hour cell with connectors has a resistance of 0.00416 ohm. The internal resistance of the cell alone does not exceed 0.0001 ohm.

MR. P. C. CLOSE, of Augusta, Ga., writes us that the North Augusta Land Co. will have about 4,000 h. p. of electric power to give out for all kinds of large manufacturing plants, at \$5.50 per horse-power annually, and that mill sites are cheap.

THE WORK OF HERTZ.—III.

BY PROF. OLIVER J. LODGE, F.R.S.

Filings in open, responding to Sphere, to Electrophorus, to Spark from Gold-leaf Electroscope.

I picture to myself the action as follows: Suppose two fairly clean pieces of metal in light contact—say two pieces of iron—connected to a single voltaic cell; a film of what may be called oxide intervenes between the surfaces, so that only an insignificant current is allowed to pass, because a volt or two is insufficient to break down the insulating film except perhaps at one or two atoms. If the film is not permitted to conduct at all, it is not very sensitive; the most sensitive condition is attained when an infinitesimal current passes, strong enough just to show on a moderate galvanometer.

Now let the slightest surging occur, say by reason of a sphere being charged and discharged at a distance of forty yards, the film at once breaks down—perhaps not completely, that is a question of intensity—but permanently. As I imagine, more molecules

get within each other's range, incipient cohesion sets in, and the momentary electric quiver acts as it were as a flux. It is a singular variety of electric welding. A stronger stimulus enables more molecules to hold on, the process is surprisingly metrical, and as far as I roughly know at present, the change of resistance is proportional to the energy of the electric radiation from a source of given frequency.

It is to be specially noted that the battery current is not needed to effect the cohesion, only to demonstrate it. The battery can be applied after the spark has occurred, and the resistance will be found changed as much as if the battery had been on all the time.

The incipient cohesion electrically caused can be mechanically destroyed. Sound vibrations, or any other feeble mechanical disturbances, such as scratches or taps, are well adapted to restore the contact to its original high-resistance sensitive condition. The more feeble the electrical disturbance the slighter is the corresponding mechanical stimulus needed for restoration. When working with the radiating sphere (Fig. 19) at a distance of forty yards out of window, I could not for this reason shout to my assistant, to cause him to press the key of the coil and make a spark, but I showed him a duster instead, this being a silent signal which had no disturbing effect on the coherer or tube of filings. I mention 40 yards, because that was one of the first outdoor experiments; but I should think that something more like half a mile was nearer the limit of sensitiveness. However, this is a rash statement not at present verified. At 40 yards the exciting spark could be distinctly heard, and it was interesting to watch the spot of light begin its long excursion and actually travel a distance of 2 in. or 3 in. before the sound arrived. This experiment proved definitely enough that the efficient cause travelled quicker than sound, and disposed completely of any scepti-

cal doubts as to the sound-waves being, perhaps, the real cause of the phenomenon.

Invariably when the receiver is in good condition, sound or other mechanical disturbance acts one way, viz., in the direction of increasing resistance, while electrical radiation or jerks act the other way, decreasing it. While getting the receiver into condition, or when it is getting out of order, vibrations and sometimes electric discharges act irregularly, and an occasional good shaking does the filings good. I have taken rough measurements of the resistance, by the simple process of restoring the original galvanometer deflection by adding or removing resistance coils. A half-inch tube 8 in. long of selected iron turnings, had a resistance of 2,500 ohms in the sensitive state. A feeble stimulus caused by a distant electrophorus spark, brought it down 400 ohms. A rather stronger one reduced it by 500 and 600, while a trace of spark given to a point of the circuit itself, ran it down 1,400 ohms.

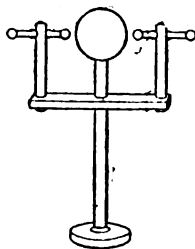


FIG. 19.

Radiator used in the library of the Royal Institution, exciting the Coherer (Fig. 18) on the lecture table in the theatre.

This is only to give an idea of the quantities. I have not yet done any seriously metrical experiments.

From the wall diagram which summarizes the various detectors, and which were prepared a month or so ago, I see I have omitted selenium, a substance which in certain states is well known to behave to visible light as these other microphone detectors behave to Hertz waves.

I want to suggest that quite possibly the sensitiveness of the eye is of the same kind. As I am not a physiologist I cannot be seriously blamed for making wild and hazardous speculations in that region. I therefore wish to guess that some part of the retina is an electrical organ, say like that of some fishes, maintaining an electromotive force which is prevented from stimulating the nerves solely by an intervening layer of badly conducting material, or of conducting material with gaps in it; but that when light falls upon the retina these gaps become more or less conducting and the nerves are stimulated.

I do not feel clear which part is taken by the rods and cones, and which part by the pigment cells; I must not try to make the hypothesis too definite at present.

If I had to make a demonstration model of the eye on these lines, I should arrange a little battery to excite a frog's nerve and muscle preparation through a circuit completed all except a layer of filings or a single bad contact. Such an arrangement would respond to Hertz waves. Or, if I wanted actual light to act instead of grosser waves, I would use a layer of selenium.

But the bad contact and the Hertz waves are the most instructive, because we do not at present really know what selenium is doing, any more than what the retina is doing.

And observe that (to my surprise, I confess) the rough outline of a theory of vision thus suggested is in accordance with some of the principal views of the physiologist Hering. The sensation of light is due to the electrical stimulus; the sensation of black is due to the mechanical or tapping back stimulus. Darkness is physiologically not the mere cessation of light. Both are positive sensations, and both stimuli are necessary; for until the filings are tapped back vision is persistent. In the eye model, the period of mechanical tremor should be, say, $\frac{1}{10}$ th second, so as to give the right amount of persistence of impression.

No doubt in the eye, the tapping back is done automatically by the tissues, so that it is always ready for a new impression, until fatigued. And by mounting an electric bell or other vibrator on the same board as a tube of filings, it is possible to arrange so that a feeble electric stimulus shall produce a feeble steady effect, a stronger stimulus a stronger effect, and so on, the tremor asserting its predominance, and bringing the spot back whenever the electric stimulus ceases.

An electric bell thus close to the tube is, perhaps, not the best vibrator; clockwork might do better, because the bell contains in itself a jerky current, which produces one effect, and a mechanical vibration, which produces an opposite effect; hence the spot of light can hardly keep still. By lessening the vibration—say, by detaching the bell from actual contact with the board, the electric jerks of the intermittent current drive the spot violently up the scale; mechanical tremor brings it down again.

You observe at the eye on this hypothesis is, in electrometer

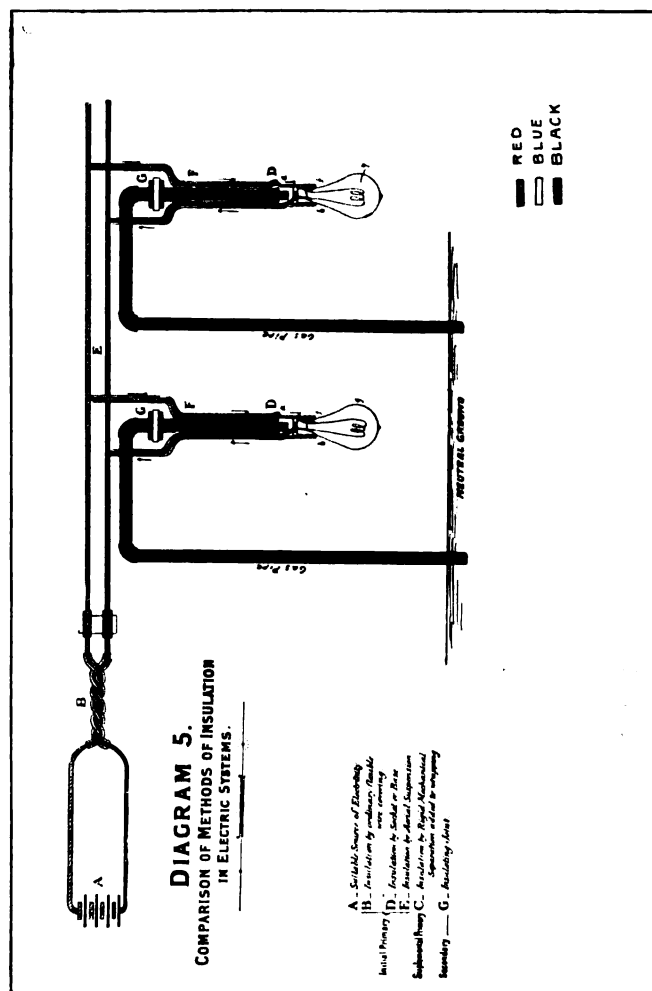
language, heterostatic. The energy of vision is supplied by the organism; the light only pulls a trigger. Whereas the organ of hearing is idiostatic. I might draw further analogies, about the effect of blows or disorder causing irregular conduction and stimulation of the galvanometer in the one instrument, of the brain cells in the other.

A handy portable exciter of electric waves is one of the ordinary hand electric gas-lighters, containing a small revolving doubler—i. e., an inductive or replenishing machine. A coherer can feel a gas-lighter across a lecture theatre. Minchin often used them for stimulating his impulsion cells. I find that when held near they act a little before the spark occurs, plainly because of the little incipient sparks at the brushes or tinfoil contacts made. A Voss machine acts similarly, giving a small deflection while working up before it sparks. And notice here that our model eye has a well-defined range of vision. It cannot see waves too long for it.

ELECTRICITY AS A FIRE HAZARD.—III.

BY W. J. JENKS.

In Diagram 5 are shown these methods of applying insulating material. A represents (by the symbol usually employed to indicate a battery of chemical cells) any source of electrical energy which may be used to supply such a system. B illustrates the insulation of the positive and negative conductors from each other by ordinary forms of "initial primary" winding, braiding or wrapping. C indicates a rigid form of insulating material—such as, for example, a wooden cleat—which separates the conductors electrically, and also mechanically, at a given distance, and is usually employed in connection with the wrapping or other insulating covering shown at B, to give additional security against leakage, thus combining the "initial" and "supplemental primary" ideas. D shows a block of insulating material, such as is ordinarily used as a base, socket or holder for a translating device. This base or socket application may combine the useful



features of both forms of insulation shown at B and C, if the initial wrapping is carried through the non-conducting base, because it electrically separates the two conductors from each other by two co-operating thicknesses of insulation and also

return with a given percentage of drop in pressure) that is ordinarily required for a system using a complete circuit of wire without the aid of the ground or of its connecting pipes. For instance, if we suppose the drop in pressure which occurs in the positive conductor of Diagram 6 between the dynamo and the lamps to be two volts, and the drop in the return circuit of iron pipes and ground to be practically nothing, we lose two per cent. of the 100 volts generated by the dynamo. If, instead of the grounded return, we were to run back a copper wire of the same size, we should in that return wire lose another two volts, or four per cent. in all. In order, therefore, to bring down this loss of pressure to the two volts (or two per cent.) to which it was formerly limited, we must double the size of both the old positive and the new negative wires so that only one volt loss will occur in each. This results in two wires, each twice as large as the former single wire, or four times the mass of copper, as already stated.

In the early history of electric lighting numerous attempts were made to make the earth thus save three-quarters of the copper or other conducting wires, as it had done in prior telegraph, telephone and other systems. A "parallel" or "multiple arc" electric light plant constructed on this principle was for some time operated by the United States Electric Lighting Company from a station in the Equitable Building in New York City, and a second "one-wire circuit" was also operated from a station at the corner of Sixth avenue and Twenty-sixth street, by the same company. The apparent economic advantage and the simplicity of construction of a system which required only one conductor, and lamp sockets which separated one terminal from the other, but separated only one terminal from the gas-pipe, was broadly advertised and thoroughly discussed at that time, as well as in other instances where similar attempts were made. It was soon found, however, that the advantages were only apparent and not real, or rather that they were overbalanced by disadvantages of unreliability of the earth circuit, and also by the consideration that the entire working pressure of the system was under all circumstances applied to the single insulation between the positive wire and the gas-piping of a building or other earth connections upon which lamps might be supported, and that thus the condition of a double strain and a quadruple expenditure of electric energy tending to short-circuit the system, which has been discussed in connection with Diagram 1, was constantly present in a system like that of Diagram 6; also, that only one ground connection was necessary to produce a short-circuit, instead of two grounds as in the two-wire system shown in Diagram 4. The three electric lamps of Diagram 6 illustrate three conditions possible in such a system. Fixture 1 illustrates practically perfect insulation of the positive conductor from the negative gas pipe, and consequently a normal flow of current through the lamp so long as the pressure is kept constant at its terminals. Fixture 2 shows the effect of a single break in the insulation, namely a short circuit with a rush of current through the reduced resistance thus occasioned, with a liability of fire, the same as in the case of the short circuit of Diagram 4. In this Fixture 2 the occurrence of a short circuit is usually accompanied by such a fall in the pressure applied to the lamp as to greatly diminish or practically extinguish its light. Figure 3 shows what happens when an insulating joint is introduced (as in the case of Fixture 1 of Diagram 4) to electrically separate the metallic portions of the fixture from the gas pipe support above. This entirely stops the operation of the lamp on the fixture so treated, and hence an insulating joint is out of place and has no legitimate use in connection with a one-wire system using the gas pipe of the fixture as part of the circuit.

The principal importance of the illustrations presented by these diagrams lies in the fact that the iron pipes which they show exemplify also the paths for leakage of electrical energy, "short cuts" to earth or from one pole to the other, which are often afforded by damp beams, plaster and other building material. Such paths usually conduct the current with more difficulty or less facility than the pipes, and are often even more dangerous because the greater resistance develops proportionally greater heat, and because by reason of its combustibility the wood itself may be carbonized by the current it carries, as a green tree will sometimes be set on fire in a wet night by an escaping current of high pressure.

"MOUNT LOWE ECHO." We are in frequent receipt, from Echo Mount, Los Angeles County, California, of the truly bright and breezy *Mount Lowe Echo*, edited by Prof. G. Wharton James, F.R.A.S., and devoted to recording all that occurs at the paradise in the South Californian Alps founded by Prof. T. S. C. Lowe, and reached from Pasadena by electric and cable road. We have never seen a better paper of its kind, and now that Mt. Lowe has become a rallying point for astronomical observation and special educational work, its columns contain much of permanent value. We are glad to note that the mountain peak is now visited daily by hundreds of tourists from all parts of the Union and Europe.

AN ELECTRIC MOTOR FIRE TRUCK is to be used at Lynn, Mass.

THWAITE'S ELECTRIC POWER TRANSMISSION SCHEME FROM THE COAL FIELDS TO LONDON.

MR. B. H. THWAITE brought an important scheme before the public in the paper which he read a short while ago before the Manchester, England, Association of Engineers.

His plan is to generate power by burning coal at the pit's mouth, and to transmit the power electrically to manufacturing centres. The coal will first have its valuable "residual products" removed. As these form the most valuable portion of the coal, the fuel actually used may be itself fairly regarded as the residual product of the distillation. Gas engines are to be employed instead of steam engines and boilers, and the power is to be transmitted by high-pressure alternating currents. Mr. Thwaite's scheme resembles somewhat that of the Niagara Power Company. The Niagara plan has the advantage of using water which costs nothing, but in the English scheme the coal costs very little, being only 3 per cent. of the cost of the power delivered in London from the Midlands.

Mr. Thwaite and Mr. James Swinburne have drawn up a report upon the project for transmitting power from the South Yorkshire coalfield to London. Fig. 1 shows clearly the plan of trunk lines, which can be utilized for serving the large

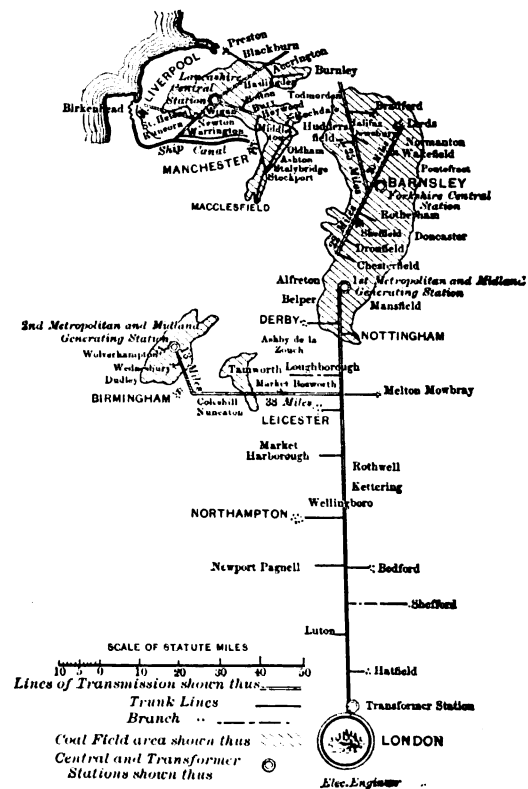


FIG. 1.—MAP SHOWING YORKSHIRE, LANCASTER, AND MIDLAND COAL FIELDS.

towns, including Derby, Nottingham, Leicester, Northampton, and Bedford. It is suggested that an auxiliary generating station shall be located in South Staffordshire, the trunk line from which would serve Wolverhampton, Birmingham, and the industrial areas in the line of its route across to the point where it joins the main trunk line serving the metropolis. Two alternate specifications have been obtained, one from the Maschinen Fabrik Oerlikon, and the other from Messrs. Brown, Boveri, & Co., Baden, Switzerland.

The arguments that may be pertinently advanced in favor of a central power generating station are almost identical with those associated with the centralization of a gas and water supply, or a sewage treatment station, but are much more cogent than in either of these cases.

Before considering the question of lighting, we may discuss power distribution generally. Let it be assumed for a moment that the textile and other factories and workshops were all connected up with the power transmission mains conveying power generated at some large centralized power generating station. The factory owner would not then have the anxiety and responsibility of his power plant, involving the care of the skilled and unskilled labor element. The space absorbed by the boilers and economizers, engine house, coal stores, and chimney would not be required, and in towns this consideration might be of impor-

tance. Then the troubles of obtaining coal and a suitable water supply, and all the attendant requirements involved in the proper care and supervision of a steam engine plant, would be avoided. The boiler insurance question would not trouble him.

The waste of fuel in early lighting and during meal hours would be avoided, and the excess of labor almost always associated with the conditions of isolated and comparatively small steam power plants would be saved. At the exact hour in the morning the mere movement of a switch would throw the plant into operation, and at night the quick turn of a handle would cut off the power. The interest on the cost of the transmitting gear, the steam engine, the steam boilers, and the buildings during fourteen hours out of the twenty-four, which is at present lost, would be avoided as far as the factory owner is concerned. The same main service would be available for lighting purposes, for elevating goods and traversing them, and for ventilating, fire extinction, electrolytic, and innumerable other purposes.

In the event of a decision to stop the factory for an indefinite period, there would be no expensive staff needed to maintain the plant in a condition of efficiency. The reduction of skilled labor required in proportion to the power produced, that would follow the establishment of a coalfield central generating station, would be very great; in fact, this feature would suffice to justify the correctness of the principle on economic grounds.

Another feature is the fact that an additional extension, involving extra power plant, could easily be accomplished, whereas it is well known how difficult in many instances it is to add extra steam-power plant, simply owing to the exigencies of space and position.

Owing to the extremely intermittent and varying character of duty, the engines working under the most favorable conditions only average throughout the day one-third of their working capacity, but under the worst conditions only one-seventh of the maximum capacity is utilized.

The coal consumption in the most favored examples of the existing system of motive power, as found by the Birmingham Commission, was 8.5 lb. per indicated horse-power hour upon the average daily horse-power, and in the worst example the coal consumption attained the phenomenal figure of 36 lb. per indicated horse-power hour. The Commission pointed out that these results were not due to the imperfect construction of the engines but were consequent on the varying character of the work required, and the necessity imposed upon each power user of maintaining a plant and steam engine equal to his maximum requirements.

One of the fundamental requirements in the choice of a motive power generating system is a means of rapidly throwing off the total load of work without involving any waste or danger. Where the source of power is the natural waterfall it is, of course, unimportant if the load is suddenly taken off, but with a steam engine plant the sudden stoppage of the engines involves very serious waste. Besides, the residual heat of the boiler water and furnace fuel is practically lost if the stoppage is for any length of time. An ideal motive power generating system should permit

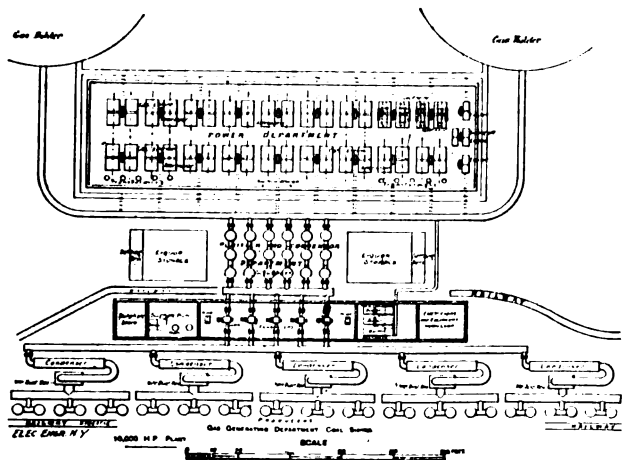


FIG. 2.—PLAN OF GENERATING PLANT.

the full power of the plant to be obtained in 10 minutes at the most. It should also be possible to suddenly throw the whole of the machinery out of action without involving a serious strain on any part of the plant; and the whole time that any part of the plant is in action it should be performing useful work at its full and most efficient load.

Anyone who understands the characteristics of steam and gas engines will recognize that the only kind of plant available is the gas engine with its own cupola generator. There are other considerations in addition to those already mentioned that are of essential importance in deciding on the ideal system, such as high full-load efficiency.

In the event of mist or fog suddenly rising, the whole of a gas engine plant could be immediately started. Mr. Thwaite, in fact, suggests the displacement, in large installations, of storage batteries by gasholders, for the storage of a convertible form of energy, available for use at a moment's notice, and involving no loss of energy by storage, for however long a time. The proposed gas plant Fig. 2, would be composed of the following constituent elements:—

1. A gas generating plant of the cupola type, fitted with automatic fuel feeding devices and automatic reversal valve arrange-

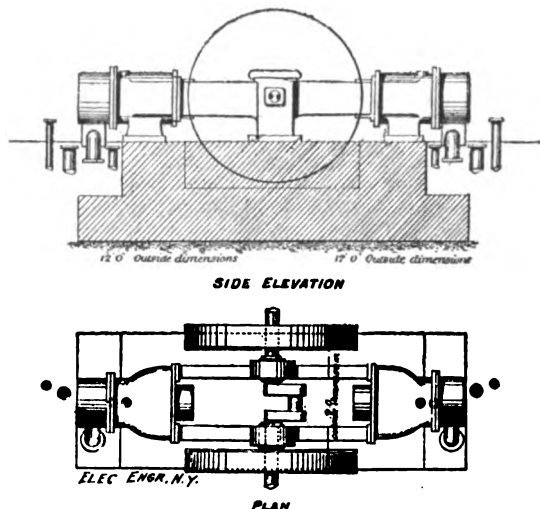


FIG. 3.—PROPOSED 300 H. P. GAS ENGINE.

ments. The fuel is led by an electric overhead cable suspension way, or by means of an ordinary electric railway system, to coal bins from which it is elevated to the generators, and by electric driving gear is then transferred to each cupola.

2. The gas generated is then led through a battery of condensers, in which any atomized fuel carried over with the gas is caught and by which the ammonia is separated as well as the tar. The purified gas is afterwards led through scrubbers of the tower form, filled with coke or brush-wood, from which the residual tar and ammonia is finally removed. The sensible heat of the gases is then recovered by special means.

3. The gas is then led to the gasholder, and is stored for use. This advantage displaces the necessity for storage batteries. When the holder is raised to a certain height, it automatically turns off the gas generating plant by degrees. A sufficient capacity for emergencies is always provided for.

4. The ammonia water is treated with sulphuric acid, and the sulphate of ammonia recovered is intended to be sold for agricultural purposes.

We give below a brief abstract of the description of the electrical part of the scheme for transmitting power from the South Yorkshire coalfield. Mr. Swinburne has collaborated with Mr. Thwaite in working out the electrical part of the scheme.

Generating Station.—The motive power is to be supplied by 36 gas engines (see Fig. 3), each capable of developing 300 brake horse-power. It may be advisable at some future time to adopt more powerful engines than these, but it is not requisite to discuss the desirability of employing larger sizes for the present. The power will be converted by eighteen alternating current generators, each of which will be coupled direct to two gas engines, so that there will be neither belts nor rope gearing. In order to secure higher and more regular speed than that of a 300 H. P. gas engine, the armature and field magnets will revolve in opposite directions, the armature being driven by one engine, and the field by the other.

The alternators will give 500 volts and 1,000 amperes each, as a lower pressure would make the switchboard cumbersome and expensive, and a dangerous tension in a station is to be avoided as far as possible. The alternating system will be designed for single currents, and both the armatures and fields will be laminated to secure perfect control, when the machines are in parallel, in spite of the throb of the gas engines.

The bus bars of the switchboard will be connected to a bank of large transformers, which will raise the pressure to 30,000 volts. One-third of these will be of the open-circuit type, their exciting currents being supplied by the capacity current due to the long overhead conductors. The advantages of their higher all-day efficiency will thus be secured, and the complication due to the condenser action of the mains will be neutralized. The remainder of the transformers, which will be in use for a few hours per day only, will be of the closed-circuit type, designed for constant heavy loads. The transformers will either be oil insulated,

or arranged upon a principle designed by Mr. Kolben, of the MaschinenFabrik Oerlikon. In cutting a transformer out of circuit the high-pressure switches will first be opened. The leads will be bare conductors carried overhead on poles. There will be three positive and three negative leads, an initial pressure of 30,000 volts being used. The middle of the circuit will not be earthed at the stations, but electrostatic devices will be arranged to give an alarm if the middle of the circuit varies from the potential of the earth. In the case of a partial earth on any conductor, that conductor will be instantly earthed automatically and cut out of circuit at both ends. The overhead conductors will be carried on creosoted wooden poles at a height of 80 feet from the ground at the lowest points in summer, and it is proposed that oil insulators be used.

It is proposed to locate the receiving station on the north side of London, and this will only contain the "step-down" transformers and switchboard. One-third of these transformers will have open circuits, and will have their exciting currents supplied by the capacity of the lines, and the rest will be of the closed-circuit type, as before. They will transform down to 2,000 volts, and in some cases to 5,000 volts. Circuits will be led from this station to the premises of the various electrical supply companies of the metropolis. Those which employ 2,000 volt distribution will substitute a distributing switchboard for their central stations. In cases where the mains are in a net, the connection will be made direct to the mains.

Fig. 4 represents a graphic table showing cost and percentage elements of electric power transmission and of units supplied to

It will be best for the existing electrical supply companies to amalgamate with one another and with the transmission company, and, in fact, to cease to have any separate existence. The whole of the metropolis can then be worked direct with less expense.

Besides the cost of the land, which will be a very nominal sum compared with the cost of land near populous centres, and the necessary buildings, there are various contingencies to be met, such as the possible necessity of underground mains across railways. The cost of way leaves, and perhaps of Parliamentary powers, must be faced, so it will be necessary to have a paid-up capital of some £400,000, and in order to make it profitable to carry out this scheme, there must be a prospect of a handsome profit on £400,000 with a maximum output of 10,000 h. p. at the generating station. Taking the maximum output at 10,000 h. p., or 7,500,000 watts, the maximum power in London will be 5,400,000 watts. On the assumption that the first power is used for lighting only, no motors being used, enough lighting can be taken up to utilize 5,000,000 watts during a heavy fog. This corresponds with a low average load throughout the year, and it will probably be safe to assume an average consumption of 1,000,000 watts only. Since the loss in the leads varies as the square of the current, the effective current throughout the year must be taken. It will be necessary to generate about 1,060,000 watts at the station, as an average throughout the year. Taking the cost of coal at 4s. 6d. per ton, after deducting the value resulting from the distillation and complete recovery of residuals, this will cost £1,100 per annum.

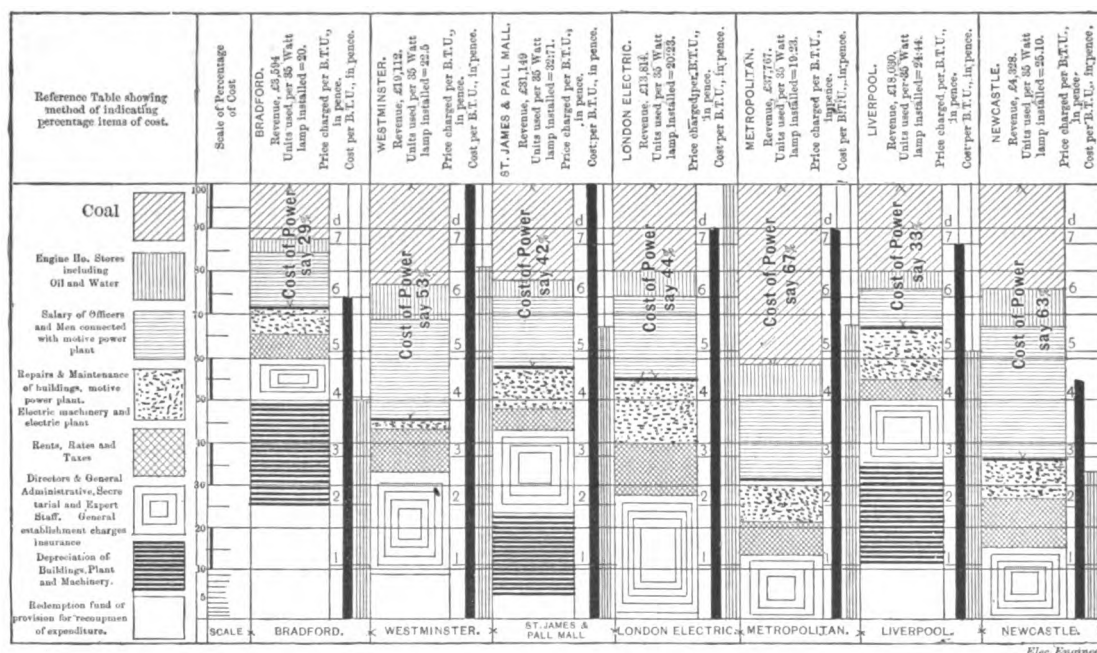


FIG. 4.—GRAPHIC TABLE SHOWING COST AND PERCENTAGE ELEMENTS OF ELECTRIC POWER TRANSMISSION.

customers. The cost of the plant for 10,000 H. P. is estimated as follows:

Twenty gas generators	£8,000	
Steam generators	1,500	
Automatic fuel conveyers	1,000	
Electricway-motor sidings	1,200	
Liquor tanks	6,200	
Two gas holders	16,800	
Two tanks	15,000	
Dust vessels	500	
Condensers and sulphate of ammonia plant	4,000	
		54,200
Thirty-seven gas engines	31,600	
Eighteen dynamo electric machines	35,000	
Exciters and engines	2,000	
Transformers	12,000	
Switchboard and gear	3,000	
		83,600
Line, including poles and insulators		80,000
Receiving switchboard	3,000	
Receiving transformers	10,000	
Connecting mains in London	10,000	
		23,000
		£240,800

The cost of power per year may be taken thus:—

Coal	£1,100
Oil and sundries	1,000
Labor	1,200
	£3,800

The cost of generating, exclusive of interest, depreciation, and standing charges, thus comes out at less than a tenth of a penny per kilowatt hour. The selling price may be estimated as follows:—

Cost of generation	£3,800
Trade expenses	8,300
Depreciation on plant at 5 per cent.	12,500
Interest on capital, making $7\frac{1}{2}$ per cent. dividends	30,000
	£49,100

This amounts to 1.84d. per kilowatt hour, the selling price to the local supply companies, and as the prices in London vary from 6d. to 8d. per kilowatt hour, there is obviously an ample margin.

In the above case the worst conditions, those of lighting a city subject to fogs, have been taken. Power taken constantly can be supplied at a much lower rate. Factory engines run about 54 hours a week, and the load factor of a large number of engines can thus be taken at about one-third. Electric power can therefore be supplied in large quantities at 0.65d. per horse-power hour, notwithstanding the power load overlapping the maximum light-

Digitized by Google

THE ELECTRICAL ENGINEER.

(INCORPORATED)

PUBLISHED EVERY WEDNESDAY AT

203 Broadway, New York.

Telephone: 3360 Cortlandt.

Cable Address: LENGINEER.

Geo. M. Phelps, President.

F. R. Colvin, Treas. and Business Manager.

Edited by

T. CONMERFORD MARTIN AND JOSEPH WITTELER.

Associate Editor: GEORGE B. MULDAUB.

New England Editor and Manager, A. C. SHAW, Room 70—630 Atlantic Avenue, Boston, Mass.

Western Editor and Manager C. KAMMETER, 1439 Monadnock Building, Chicago, Ill.

New York Representative, 203 Broadway, } W. F. HANKE.
Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada, - - - - - per annum, \$3.00
 Four or more Copies, in Clubs (each) - - - - - 2.50
 Great Britain and other Foreign Countries within the Postal Union " - - - - - 5.00
 Single Copies, - - - - - .10
 [Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1893.]

EDITORIAL ANNOUNCEMENTS.

Addresses.—Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of THE ELECTRICAL ENGINEER. Communications for the attention of the editors should be addressed, EDITOR OF THE ELECTRICAL ENGINEER, 203 Broadway, New York City.

VOL. XVIII. NEW YORK, JULY 18, 1894. No. 324.

CONTENTS.

EDITORIAL:—	PAGE.
Electricity from the Coal Fields.....	50
The Work of Hertz.....	51
Electricity as a Fire Hazard.....	51
Electric Canal Boat Propulsion.....	51
ARTICLES:—	
Locating Faults and Crosses (Illustr.).....L. C. HILL.	41
Freeman's New Direct Current Motor and Generator (Illustr.).....	41
Storage Battery of the Electric Power Storage Co. (Illustr.).....	42
The Work of Hertz.—III. (Illustr.).....PROF. OLIVER J. LODGE.	43
Electricity as a Fire Hazard.—III. (Illustr.).....W. J. JENKS.	44
Thwaite's Electric Power Transmission Scheme from the Coal Fields to London (Illustr.).....	46
ELECTRIC TRANSPORTATION DEPARTMENT:—	
The Lamb Electrical Cableway for Canal Boat Towing and Logging (Illustr.).....	52
The McKeesport and Wilmerding Electric Railway (Illustr.).....	53
MISCELLANEOUS:—	
Electrostatic Rotations in Rarefied Gases (Illustr.).....RICCARDO ARNO.	54
NEWS AND NOTES:—	
More Search Lights for New York Waters.....	52
Electric Lights in Battle.....	55
Electric Lighting in Glasgow.....	55
The Broadway Cable Signal System, New York.....	55
Effect of Telegraphy on Women Operators.....	59
Killing Rate by Electricity in Philadelphia.....	59
To Prevent Collisions at Sea by Searchlight.....	59
SOCIETY AND CLUB NOTES:—	
Meeting of the Canadian Electrical Association.....	49
Northwestern Electrical Association.....	49
American Electro-Therapeutic Association.....	49
LITERATURE:—	
Emmet's "Alternating Current Wiring and Distribution.".....	56
"American Street Railway Investments.".....	56
Houston's "Electricity One Hundred Years Ago and To-day.".....	56
LEGAL NOTES:—	
Edison Electric Light Company et al. vs. The Citizens' Electric Light, Heat & Power Company.	56
LETTERS TO EDITOR:—	
Series Armature Winding.....G. J. JUNKER.	55
Electrolytic Copper for Railway Feeders.....LIVY WIRE.	55
Priming of a Babcock & Wilcox Boiler (Illustr.).....R. S. HALE.	55
INVENTORS' RECORD:—	
Classified Digest of U. S. Electrical Patents Issued July 3, 1894.....	56
PERSONAL:—	
Crehore-Buck. (Married).....	56
Mr. W. H. Browne.....	56
Col. Wheelwright.....	56
TRADE NOTES AND NOVELTIES AND MECHANICAL DEPARTMENT:—	
Sales of M. A. Green Automatic Engines.....	57
The White Adjustable Holder for Incandescent Lights. (Illustr.)—Portable Alternating Current Meter. (Illustr.)—The Rushmore Constant Current Arc Lamp. (Illustr.)—The National Conduit Mfg. Co.....	58
High Economy Incandescent Lamps—New Catalogue of the Electric Storage Battery Co.—The Triumph Electric Co.—Earnings of the New York Edison Co.....	59
New Telephone Enterprise in Philadelphia.—Packard Mogul Lamp.—The "Acme" Portable Voltmeter.—Western Notes.—New York Notes.—Philadelphia Notes.—Canadian Notes.....	60

ELECTRICITY FROM THE COAL FIELDS.

A GENERAL survey of the relative activities in the various branches of electrical work shows an unmistakable preponderance in the domain of electric power distribution, in one form or another, and more particularly in the utilization of water powers. Leaving out of consideration the work now rapidly approaching completion at Niagara, the success already attained with other similar installations by no means insignificant, both here and abroad, has demonstrated that ample and secure returns can be found for capital invested in such plants. Engineers, of course, are turning their attention, first, towards seeking to utilize those natural forces which involve the least number of conversions to bring them to the door of the consumer, and hence the attention paid more particularly to the exploiting of existing water powers. But there are some who are even now looking beyond and who believe that the time is not far distant when the transportation of coal, at least as an article for the generation of power, will become a thing of the past. Without stopping to discuss the effect of a total cessation of coal transportation on the profits of the railway companies, we deem the serious consideration of such a problem at the present time by no means too early. At any rate, a discussion of all the questions involved can do no harm, while on the other hand it may lead to a clearing away of doubts and misstatements, which frequently delay the consummation of worthy enterprises. As bearing upon this subject, we present, in this issue, a scheme mapped out by Messrs. Thwaite and Swinburne, for the generation of electric power in the centre of the Midland coal fields in England, to be transmitted to the various manufacturing towns in that busy district and south to London. So far as the electrical features are concerned, the employment of the alternating current, with step-up and step-down transformers, presents little novelty of detail, but the plan of operation outlined for the generation of power contemplates the utilization as fuel of the gas obtained from the coal at the mine and feeding gas engines of 300 H. P. each. According to this plan, the cost of delivery of electric power in London is estimated at 2½ cents per kilowatt hour; and since the present average rate of charge in London is 14 cents, there would seem to be an ample margin of profit in the undertaking. If these figures are anywhere near the truth it ought not to be difficult to find capital to carry it out. The figures given place the cost of power at close onto \$16,000 for 10,000 H. P., which is equivalent to \$1.60 per H. P. per annum.

It may be of interest to compare this item with that which could be taken as the cost for power alone for similar undertakings in the United States. The enormous culm piles, containing millions of tons of fuel, now dotting the Pennsylvania and other coal fields in all directions, have long been the subject of discussion, but all attempts at their utilization on a large scale have thus far proved without results. The material being of such a nature that its transportation to any distance is out of the question, it has thus far been employed only locally and even then to a very limited extent comparatively, so that, far from diminishing, the number and size of these waste coal piles is continually on the

increase. It has more than once been suggested that with an electrical generating plant placed close beside these coal piles, electric power might be profitably transmitted from the Pennsylvania coal fields to New York, and as some indication of the probable feasibility of such a plan, some recent statistics, gathered by the Scranton Board of Trade, may prove of value.

Investigations in that city have shown that improved steam plants, aggregating 8,760 H. P., use 394 tons of fuel per day, while unimproved plants, aggregating 7,362 H. P., consume 450 tons per day of twenty-four hours, or a total of 16,122 H. P. using 844 tons. This fuel costs 25 cents per ton delivered at the boiler, or \$211 per day for 16,122 H. P.; that is, $1\frac{31}{100}$ cent per H. P. per day of 24 hours. For 300 working days this would give a total cost per H. P. per year of \$3.93. Adding to the above \$2 per H. P. per year for the cost of firing, interest on plant, repairs, etc., gives \$5.93 per H. P. per year.

The figures just given are the results of actual practice, and show an apparently wide discrepancy in the cost as determined in the case discussed by Messrs. Thwaite and Swinburne. It must be borne in mind, however, that in their calculations they regard the gas obtained from the coal as a sort of by-product; to this, however, must be added the very important fact that, by the employment of the gas engine, three times as great an efficiency, and more, could be obtained in the utilization of the calorific value of the fuel. This point is by no means to be overlooked. Although the coal as culm would hardly be suitable for gas production, it would be advisable in figuring on a scheme of this kind to consider the production of water gas in hard coal districts, and the use of gas engines. The question would then resolve itself into the comparative cost of a steam and a gas generating plant. Leaving these questions for the future and assuming the figures given for the cost of steam power at Scranton to be correct, there is here a field of operation well worthy of serious attention. Taking as a basis the figures for cost of transmission given by Messrs. Houston and Kennelly (see *THE ELECTRICAL ENGINEER*, May 2,) in their estimate of the cost of the electrical transmission of power to various distances from Niagara, it would seem that New York and Philadelphia, as well as a large number of other cities, are well within the limits of economical zones, with the various Pennsylvania coal fields as centres, while the same would hold true for many other large cities in various states having coal beds. For the present all eyes are turned towards Niagara and much of the future work in large power transmissions will depend upon the outcome of that undertaking. Its success once established, however, we feel certain that the coal fields will become the next point of attack for the electrical engineer. It is safe to say that probably every existing electric light company would be willing to take its power directly in the form of current from some independent source at the present cost for such power, thus relieving itself of the most exacting part of its operations, and leaving it free to devote all its energies solely to distributing the current to individual consumers. Indeed we have reason to believe that the managers of one of the largest central station companies in New York would welcome such a plan, notwithstanding their present enormous investments in engines, boilers and electrical machinery.

THE WORK OF HERTZ.

In this issue we continue the lecture delivered at the Royal Institution by Dr. Lodge on the work of Hertz. Admirable in clearness and simplicity, Dr. Lodge, very properly, has not confined himself exclusively to the work of Hertz alone, but has given us much of value on what preceded and has followed the first announcement of Hertz in 1888. There is, probably, none who came so near reaching the desired result showing the identity in character of light and electro-magnetic radiation as Dr. Lodge himself and on the other hand none who has carried Hertz's work farther along. Much of Dr. Lodge's lecture is taken up by a description of the various methods and apparatus for detecting electric oscillations, and it is, indeed, astonishing to find how many devices are sensitive to them. Dr. Lodge's own "coherer" must be counted among the most simple and beautiful of these and will, no doubt, be largely employed in future investigations in this field. The effect of even slight mechanical disturbances upon detectors of the coherer type leads Dr. Lodge, who delights in analogues, to suggest a possible explanation of the action of the eye, which in that sense brings the eye under the category of the most sensitive detectors of electric vibrations.

ELECTRICITY AS A FIRE HAZARD.

ELECTRICITY has been proved to be so safe a medium for light and power distribution that electrical journals have long since ceased to reply to the aspersions that are still cast on it from time to time by those who have ulterior objects in view. But on the other hand there are none better able to judge of the real danger due to loose methods of construction, than electrical engineers themselves. Where but an apparently insignificant "leak" may in time be aggravated into a serious fault it behooves all connected with the installation and operation of modern electrical apparatus to know exactly in what manner the danger is created and to provide the necessary means for its prevention. In the admirable paper on "Electricity as a Fire Hazard" by Mr. W. J. Jenks, there will be found a most clear and exhaustive explanation of many of the effects which have puzzled and annoyed others besides the fire underwriters. It is too much to expect that the fire records will ever be entirely free from electrical losses, but the work which the various Boards of Fire Underwriters and the National Electric Light Association have accomplished in bringing about improved methods of construction has already done so much towards increased safety that the loss from this cause is gradually but surely assuming an asymptotic character.

ELECTRIC CANAL BOAT PROPULSION.

THE experiments in electric canal boat propulsion carried out last fall on the Erie Canal, near Rochester, served to draw attention to the subject in a manner which no amount of papers read before engineering societies could have accomplished. Those experiments were confessedly merely of a tentative nature and were by no means intended to exemplify the final methods to be adopted. The employment of the trolley, as in electric railway work, in connection with the screw propeller, though having many advocates, has nevertheless called forth criticisms in certain quarters, and to meet these it was early proposed to adopt an electric system involving a direct pull. Among the various means for this purpose that have been proposed we describe this week the first actual attempt of this kind, in America, made at Trenton, N. J. Originally intended for log hauling, the Lamb system appears to be thoroughly feasible, both mechanically and electrically, and to do away with the objections to the trolley system, if such really exist.

ELECTRIC TRANSPORTATION DEPARTMENT.

THE LAMB ELECTRICAL CABLEWAY FOR CANAL BOAT TOWING AND LOGGING.

In our last issue we gave an abstract of a paper read by Mr. Richard Lamb, of New York, before the American Society of Civil Engineers, at Niagara, describing his system of electrical haulage for logging and canal boat towing. Through the courtesy of Mr. Lamb we are now enabled to give some further interesting

details. The motor is made with a truck, having grooved wheels to run upon the cable. A horizontal axle on the frame of the truck, located below the centre and between the wheels, supports a hanging-frame. An elliptically grooved sheave is attached to this frame, which is revolved by means of a newly patented worm, or

permanent bracket is used. This $\frac{1}{4}$ inch cable is attached firmly at either end and grounded. In practice this cable does not require to be very taut.

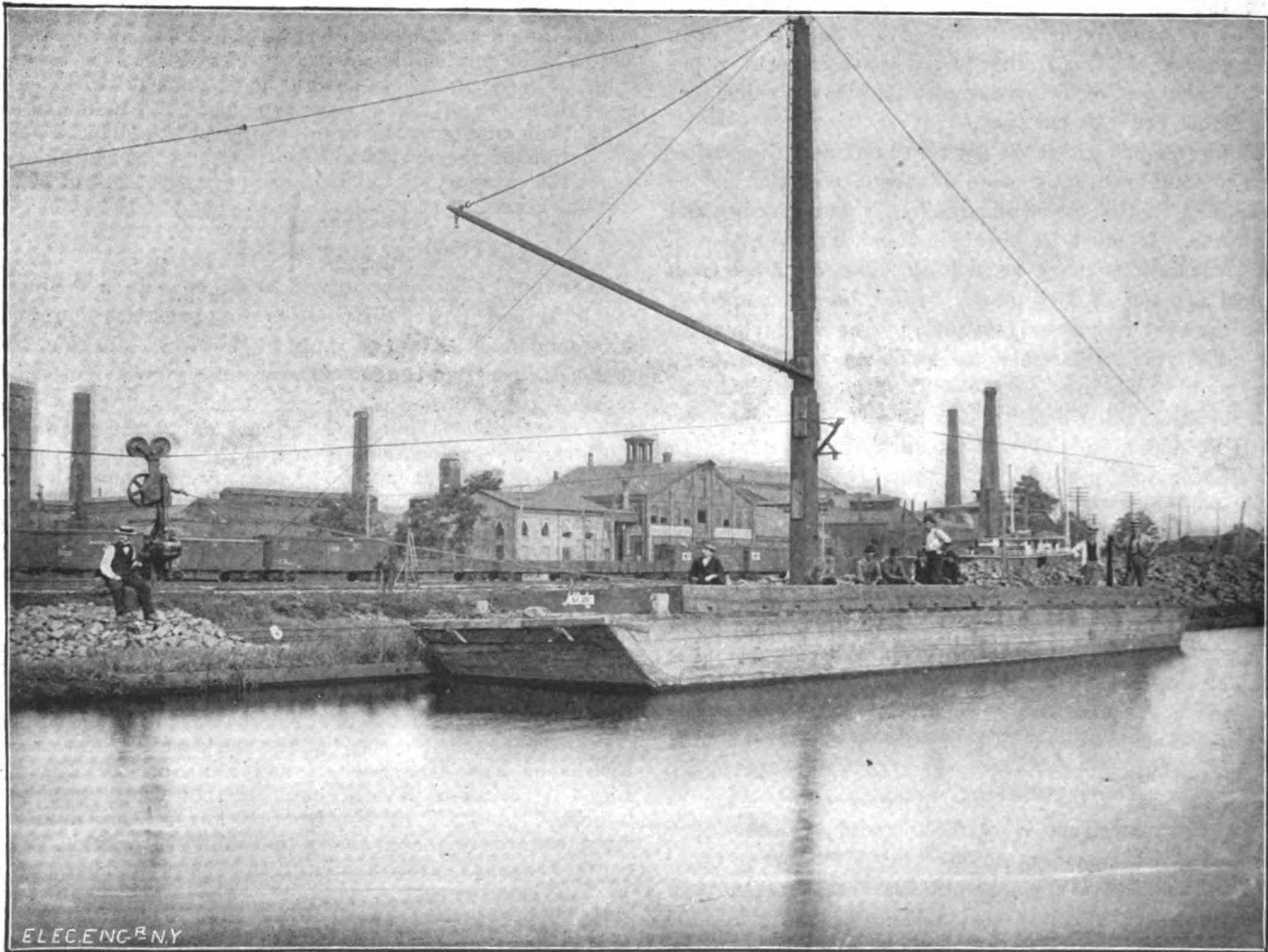


FIG. 1.—THE LAMB ELECTRICAL CABLEWAY FOR CANAL BOAT TOWING AND LOGGING.

details and two illustrations, showing the system in operation at Trenton, N. J.

As shown in Figs. 1 and 2 the system consists of a cableway along the towpath supported by brackets from 100 to 150 feet apart, placed upon trees or substantial columns, and insulated from the ground. The main, or bearing cable has a copper core, having large steel wires surrounding it, giving ample strength as well as being a good conductor for the current, and presenting a good wearing surface for truck wheels to roll upon.

The cable rests in steel saddles on the bracket, having wedge clamps upon them to hold the cable rigidly to the bracket; these saddles are insulated from the brackets. Under the bracket proper, is an auxiliary bracket having a V-shaped saddle with its mouth opened at the top, and having jaws projecting inwardly to engage the $\frac{1}{4}$ inch traction cable, preventing it from coming out of the saddle, except when temporarily lifted when the car passes a bracket. Owing to this feature, the cable is not confined to a straight line, but can be located with right and left curves. The bracket is easily removed and in canal-boat towing a simple per-

wedge-gearing, driven by a 5 k. w. Lundell electric motor, with vertical shaft.

By taking a couple of turns of the $\frac{1}{4}$ inch traction cable, around the elliptically grooved sheave, when the electric motor revolves the gearing, the sheave winds up, and at the same time pays out on the $\frac{1}{4}$ inch cable, the action being the same as that of any elevator, only the direction of the pull of this motor is horizontal instead of vertical. The direction of the pull on the traction cable is parallel with the bearing cable; in consequence, the motor can easily climb steep grades.

The hanging-frame is divided just below the level of the cable, and is bolted together, with provision for thorough insulation of the upper from the lower part of the hanging frame. An insulated wire is connected with the upper part of the frame; this extends to the rheostat, which in turn is connected with the motor. The return current is allowed to pass through the frame to the elliptically-grooved sheave, then through the $\frac{1}{4}$ inch cable to the ground.

In canal-boat service, the towing hawser contains insulated

wires. This cable is rigidly attached to an eye-bolt, just below the point of insulation on the hanging-frame and from the end of the rope, the various wires are connected with their respective connections. The bite of the rope is connected with a clamp made of non-conducting material; the socket of this clamp, and the pin which engages in it, which contains the wires leading to the reversing switch and rheostat, is made irregular in shape, so that



FIG. 2.—THE LAMB ELECTRIC CABLEWAY.

corresponding wires are obliged to come in contact, when the clamp is connected.

In operating, a canal boat will apply for a motor; if the boat does not own a rheostat one will be placed on board. The towing rope will be attached to the sampson-post, leaving the end of the rope free. The wires in the cable will be connected with their respective wires in the rheostat by the clamp as described, and the boat proceeds.

On approaching another boat coming in the opposite direction, motors are stopped, cables are disconnected, and boats exchange cables and consequently motors, and proceed. Of course, an extra cable, one above the other, or one on both sides of the banks, would obviate the necessity of exchanging motors.

The trial plant illustrated, is operated with a 15 K. W. Edison

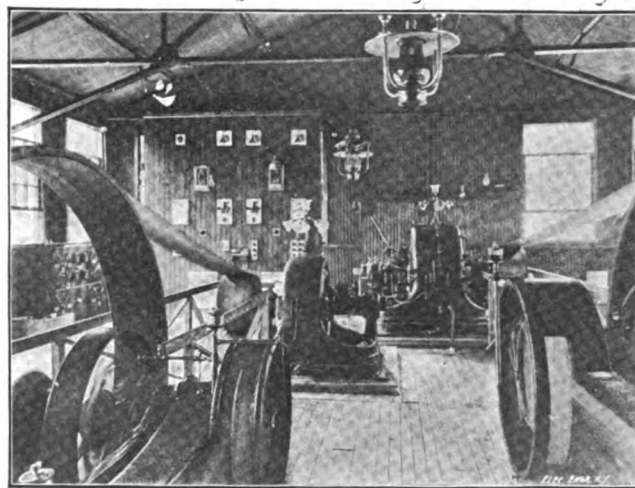
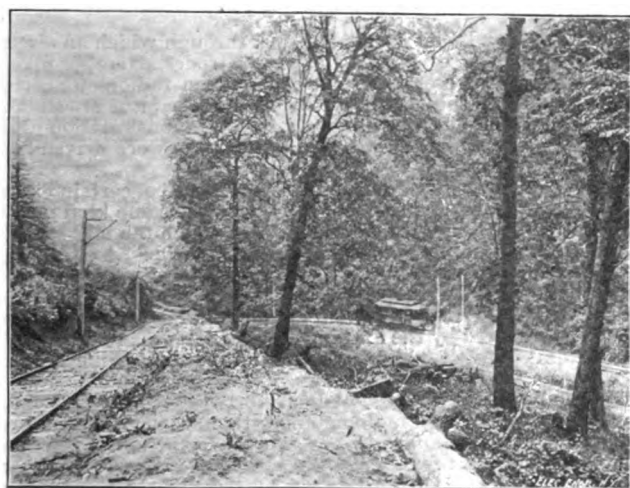
THE MCKEESPORT AND WILMERDING ELECTRIC RAILWAY.

EVER since the adoption of the electric motor for the propulsion of street cars, there has been a growing confidence among many in the eventual substitution of electricity for steam in long-distance transportation. The belief has gained considerable ground, particularly during the last year, aided, no doubt, by the construction of such electric roads as those which are paralleling the Pennsylvania and New Jersey Central roads in New Jersey, and the Baltimore and Ohio road in Ohio. At present, faith in large inter-urban electric railways can legitimately result only from experience gained in the operation of inter-linking local roads, or from the installation of such electric railways as surmount more than the usual difficulties encountered in street railway constructions.

An example of a most successful and interesting electric road of the last mentioned class, has recently been put in operation in the western part of Pennsylvania, between the towns of Wilmerding and McKeesport. The former, fourteen miles southeast of Pittsburgh, on the Pennsylvania Railroad, is a flourishing little place which owes its existence chiefly to the establishment there of the factories of the Westinghouse Airbrake Company, which employs some 1,500 men. Four miles south of Wilmerding, separated by a mountain 1,200 feet high, is the city of McKeesport, on the banks of the Monongahela River, and fifteen miles from Pittsburgh via the Baltimore and Ohio Railroad. It is a city having a population of 85,000 and the manufacturing centre of the National Tube Works, a large glass factory, and several other thriving industries. Until last year, the only method of transportation from one town to another was by railroad via Pittsburgh, a trip of 29 miles.

For some time back the two cities have been considering the project of establishing a steam road which might give more direct communication between them, but the numerous sharp curves and necessarily steep grades that would be encountered in ascending and descending a 1,200-foot elevation in a distance of about four miles, made such a road impracticable. After much careful inquiry and consideration of existing conditions it was decided that an electric road could be built which would operate successfully. A company was organized under the name of the McKeesport & Wilmerding Railway Co., which engaged the services of Messrs. Taylor, Romine and Scott, engineers, from McKeesport. After months of careful work, the engineers succeeded in locating a route which was entirely feasible, although having some grades as steep as 11 per cent. The route surveyed, shown in the accompanying maps, was accepted by the railroad company and the construction of the road begun.

The electric road starts from the Pennsylvania Railroad depot in Wilmerding, and runs to the outskirts of McKeesport where it connects with the McKeesport and Reynoldston Passenger Railway, a local electric road that has been in operation in McKeesport for several years. The route selected passes through the principal



GLIMPSE OF LINE AND INTERIOR OF POWER HOUSE; MCKEESPORT AND WILMERDING ELECTRIC RAILWAY.

dynamo, at 220 volts. The motor is a 5 K. W. Lundell, provided with a metal bonnet to protect it from rain, but which is not shown in the illustration. The ease in which heavy logs can be pulled in from a distance on either side of the cable, and lifted and carried upon the car is remarkable. The large scow shown is gotten under weigh quickly, boats can be pulled at the rate of six miles per hour with the motor now made.

streets in Wilmerding, and after leaving that town commences a very sharp and tortuous climb to the summit of the mountain. In order to mount the elevation the road twists in and out and doubles upon itself in a manner more interesting and picturesque for passengers than advantageous for economical operation. The top of the mountain is comparatively flat, so that the line runs directly towards McKeesport. On the south side of the elevation the

grade is less steep and not so interesting, as trees and hills preclude any such view as is offered on the Wilmerding slope.

Since the opening of the road a small town called East McKeesport has sprung up on the very top of the mountain, where a hotel and picnic grounds afford a convenient place of recreation for the people of both towns. Throughout the village and picnic grounds are strung direct current constant potential arc lamps operated in series of nine from the 500-volt railway circuit, and giving to the rustic little town lighting facilities that many a large city might envy.

The rolling stock of the Wilmerding road consists of three 18-foot passenger cars of the ordinary type built by the New Castle Car Co., New Castle, Pa. They are supplied with McGuire trucks each equipped with two 80 H. P. single reduction Westinghouse motors of the No. 3 type. In addition there are two open cars reserved for summer use, which are similarly equipped. As might be expected, the traffic is not exclusively passenger transportation, the entire mail, freight and express exchange between the two cities passing over the electric road. For the handling of express and freight, the company has a special baggage car, shown in one of our illustrations. It is of the same general dimensions as the passenger cars but equipped with two 40 H. P. Westinghouse motors of the new No. 10 type with No. 14 controllers. All the cars are supplied with special rail brakes, which were found necessary to insure safety on the very heavy grades encountered in the construction of this road. The brakes consist of two heavy iron shoes on each side of the track between the forward and the rear wheels. A lever on the car platform enables the motorman to force the shoes down against the truck, lifting, in part, the weight of the car from the axles. These brakes are only supplementary to the ordinary car brakes which, except in freezing weather, are sufficient for perfect control of the car.

The power house and carbarn are located about midway between Wilmerding and McKeesport on the top of the mountain. Both buildings are built of brick and iron and are very substantial throughout. The station contains two Pierpont boilers of 100 H. P. each, in which steam is generated at about 110 lbs. pressure. The engine and dynamo room is entirely separate from the boiler room. The engines are two in number, consisting of one 250 H. P. Russell engine and another 90 H. P. machine of the Buckeye type. The larger engine is belted direct to a Westinghouse compound wound multipolar generator of 150 H. P. capacity. The other engine is similarly connected to an 80 H. P. generator of the same type and manufacture. The switchboard is built out from the wall and equipped with Westinghouse apparatus consisting of the usual voltmeters, ammeters, circuit breakers, rheostats, lightning arresters, etc. The site of the power house on the top of the mountain where no water for boilers, etc., is available, would seem at first glance to be very poorly chosen, but the company fully considered the advantages and disadvantages of the location. Within a few hundred feet of the power house, they were able to purchase several acres of valuable coal land, where they own and operate a coal mine which supplies for the station a high grade of fuel at the lowest possible figure, and a pump operated by an electric motor, which is kept constantly going



ELECTRIC FREIGHT CAR ON THE McKEESPORT AND WILMERDING RAILWAY.

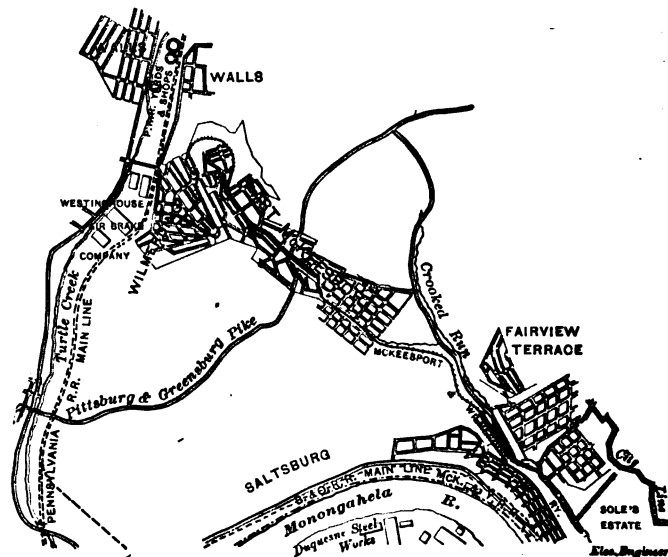
supplies water from the foot of the mountain. This slight disadvantage, however, does not begin to offset the advantages of very cheap location, accessibility of fuel, and economical distribution of power.

The road is single track throughout its length with turnouts conveniently located. The rail used is of the "T" pattern of about 52 pounds per yard, laid on chestnut ties three feet between centres.

The rails are all bonded by No. 4 copper wires and connected to a ground return which is itself grounded at frequent intervals

by means of plates buried to a depth of seven feet in the earth. The overhead line consists of one No. 0 copper trolley wire with a No. 0000 copper wire feeder which extends from the power house to the Wilmerding end of the line.

One of the most interesting features in connection with the operation of this road is the difficulties that have been met in the way of lightning and static effects. Presumably because the



MAP SHOWING ROUTE OF McKEESPORT AND WILMERDING RAILWAY.

electric circuit extends both over high ridges and into winding valleys, through woods and across open fields, there result in the power house, very heavy static discharges. These are noticeable particularly during thunder storms but sometimes occur even in clear weather. During heavy storms they have become so violent at times that it has been found necessary to shut down the complete plant until the storm has passed over. Recently, however, these conditions have been very carefully studied and steps taken which it is believed will effectively protect the electric apparatus during the severest atmospheric disturbances.

MISCELLANEOUS.

ELECTROSTATIC ROTATIONS IN RAREFIED GASES.

BY RICCARDO ARNO.

CROOKES found that a rarefied gas, through which an electric discharge is passed by means of two electrodes, exercises upon a small mill-wheel resembling that used in a radiometer certain actions which, if the various parts of the apparatus are suitably disposed, have the effect of producing a continuous rotation of the mill-wheel, as it would take place if its vanes were driven from the cathode to the anode.¹

The object of the present note is to describe certain experiments which show that a phenomenon of the same kind may be obtained by subjecting the rarefied gas in which the mill-wheel is immersed to the action of a rotating electric field.

The method previously employed² has also been used for obtaining the rotating field necessary for these experiments, being based upon a simple alternate difference of potential between two fixed points, represented by the extremities of the secondary coil of a large Ruhmkorff coil without a commutator, acting like an ordinary alternate current transformer.

To exhibit the new phenomenon referred to, it is not advisable to employ the ordinary radiometers with mica vanes, since even when these are surrounded by gas at ordinary pressure, forces act upon them which are due to the action of the rotating electric field upon the mica.³ I therefore had recourse to an apparatus specially constructed for the experiments, consisting of a mill-wheel, *m*, with four very delicate brass vanes mounted in a glass bulb, *v*, containing very highly rarefied air. It was in fact only by working with a completely metallic mill-wheel that I could make sure of having eliminated all direct action of the rotating field upon the vanes of the wheel, and of ascertaining the new effects due to the presence of the rarefied gas.

If the apparatus described is introduced between two pairs of

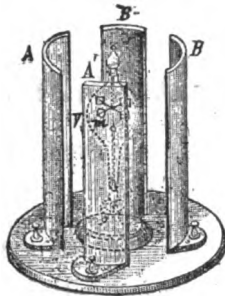
1. *Phil. Trans.*, 1879, I., p. 152.

2. *Rendiconti del Lincei*, October 16, 1892, p. 284.

3. It has in fact been proved, in the paper quoted above, that a dielectric placed in a rotating electric field is subjected to a couple tending to make it rotate in the direction of the field itself.

copper strips, A B and A' B', arranged crosswise and enclosing the rotating electric field, and the field intensity is great enough and the bulb well dried, it is observed that the brass vanes commence to rotate in the same direction as the field itself. And if the field is reversed while the vanes are turning in one direction, the metallic wheel is rapidly brought to a standstill, and then commences to rotate in the opposite direction.

In my experiments, performed with an alternating current of frequency 40 and a distance of 15cm. between the strips, the effective difference of potential between the terminals of the secondary wire of the induction coil was about 7,500 volts. Under these conditions corresponding to an electric field rotating with a



ELECTROSTATIC ROTATION IN RAREFIED GASES.

velocity of 40 turns per second and having an intensity of 1.67 C. G. S. electrostatic units, the metallic wheel acquired a velocity of 50 turns per minute.

I have said that, to exhibit the new phenomenon described, the experiments must be conducted with wheels with conducting vanes. I must add that this condition, necessary in order to avoid the direct action of the rotating electric field upon the wheel, is also sufficient. Suitable experiments have, indeed, shown me that, whilst in air under ordinary pressure four mica vanes arranged crosswise rotate with the field like all dielectrics, there was not the slightest couple exerted upon an entirely metallic wheel. Such a wheel, even when suspended in a very intense rotating field by a very fine and long silk thread, remained fixed in the field.

LETTERS TO THE EDITOR.

SERIES ARMATURE WINDING.

As I am a constant reader of your paper, I feel at liberty to ask a few questions.

1. Is there a series generator (or straight current dynamo) in which all the coils on the armature are in series with each other?
2. Would it not be an advantage to have the coils on an armature arranged so they could be connected in any way desired, while the machine is in operation?
3. What gain would there be, if any, in having all the coils in series instead of the two halves in parallel.

I have studied up a device of that nature and would experiment and find out for myself, but I have not the means to do it with. Therefore you will oblige me very much with the answers to the three question if possible.

MT. VERNON, ILL.

G. J. JUNKER.

ANSWER:—1. Any armature with an uneven number of coils, or with an even number of coils, but an uneven number of poles, may be so connected that all the coils in series form one continuous circuit, in which all the currents generated in the single coils, flow in the same direction, and the E. M. F.'s therefore are added to each other. In some high potential machines for power transmission purposes this has in fact been done.

2. There is no practical case in which such an arrangement would be of any advantage. In circuits of varying voltage (arc light circuits) the current flow is to be kept constant, and this cannot be done by means of variable armature connections, as in the latter case the total output of the machine would not be altered by changing from one connection to the other; by changing from parallel to series connections, for instance, in a bi-polar dynamo, the voltage is doubled but the current output halved. Besides, such a change could not, without danger of injury to the machine, be made while the latter is in operation, since the relative position of the two brushes, is so widely different for the two methods of connection, that the adjustment of the brushes would have to be made (by means of a specially constructed brush-rocker, which enables the simultaneous shifting of both sets of brushes, as well as the shifting of one set separately, while the other is at rest) while the machine is not generating any current.

3. The gain of having all the coils in series, in a very high potential dynamo, is a decrease in the cost of manufacture. For, instead of winding on the armature two parallel circuits of very

fine wire, carrying half of the small current output, by the series method of connecting only half the number of turns of a wire, still thin, is required, carrying the total current. Thus the work of winding is reduced to one half. Since one wire takes up less space than two of half its cross-section, a further advantage of having all coils in series consists in being able to get a higher E. M. F. from a given winding space of an armature than could be obtained if the two halves were connected in parallel. A disadvantage of the series method is increased sparking at the brushes, since the number of coils under each pole is not equal, their total number being uneven.—EDS. E. E.

ELECTROLYTIC COPPER FOR RAILWAY FEEDERS.

YOUR editorial in the issue of July 4, on "Electrolytic Copper," is very timely and interesting, bearing upon the question of relation in price of electrolytic to pure Lake copper. There are other questions which may come before the notice of electricians or managers of electric light and electric traction companies.

First: Does electrolytic copper, when made into wire, produce the same results as regards conductivity without greater loss of power?

Second: Has electrolytic copper the same elasticity as soft-drawn copper wire? Is it not more brittle and liable to scale, thereby necessitating heavier insulation, which increases the price per mile, particularly where light and traction companies purchase insulated wire by the pound?

In regard to the first question, information is desired, as in a recent case of a No. 0000 feeder a greater loss was apparent and the wire, supposed to be Lake copper, scaled when cut; also, when the insulation was stripped back from the ends, the line man, to use his own words, "noticed a difference in the way the wire acted."

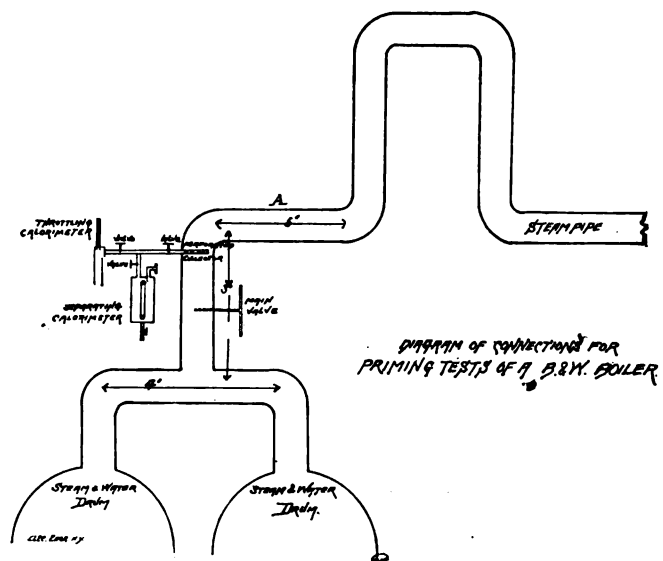
The second question is asked for information also, as it presents a condition to consider in the increased expense and loss of conductivity if the wire scales on the surface and the scales enter the insulation. This would probably not occur immediately, but it is not usual to string wires for a few months only.

LIVE WIRE.

PHILADELPHIA, July 9, 1894.

PRIMING OF A BABCOCK & WILCOX BOILER.

In reply to Mr. E. H. Peabody's letter in your issue of July 4, I enclose a diagram of my connections. The steam collector is a $\frac{1}{4}$ -inch pipe with perhaps half a dozen $\frac{1}{8}$ -inch holes. It extends 6 inches across the 8-inch steam pipe. The throttling calorimeter uses about 240 lbs. of steam per hour, and to show 6 per cent. priming for 20 minutes would need 5 lbs. of water. 20 per cent.,



as shown by the separating calorimeter would require over three times as much.

If in any case it was water of condensation which collected in the pipe and was drawn in to the calorimeter then a test with the boilers banked or with the main valve shut should show wet steam, since with no current, the water should have its best chance to collect on its pipes. These tests, however, show dryer steam than at any time while the boiler is steaming. In every case I run steam through the calorimeter for about three minutes before paying any attention to evidence of priming.

R. S. HALE.

Boston, July 7, 1894.

LITERATURE.

Alternating Current Wiring and Distribution. By Wm. Le Roy Emmet, Member A. I. E. E. New York: 1894. THE ELECTRICAL ENGINEER, N. Y., 76 pages, $4\frac{1}{2} \times 7$. Price, \$1.

THE introduction of alternating current in electric lighting and power work opened up a tremendous field which had heretofore been beyond reach with the continuous current, and the unanimity with which station managers adopted the system was such that it now occupies a position well nigh impregnable. While the general laws governing alternating current distribution do not differ in principle from those due to the continuous current, it was nevertheless soon found that certain modifications had to be introduced in order to secure the best results in wiring, and this has been particularly the case in the more modern long distance power distribution.

It is the object of this valuable little work to point out, in a practical way, the laws governing the distribution of alternating currents, and it addresses itself particularly to practical men. In carrying out his programme the author first describes the various influences effecting alternating distribution, such as the surface or "skin" effect, the influence of neighboring alternating circuits, and the self-inductive effects, discussing each of these and showing the manner in which they must be taken into account in laying out lines in order to get the most economical size of conductors for the given amount of work. He next takes up the effects of transformers and motors in circuit, and shows by practical determination and an actual case how much the generator must be over-compounded in order to be self-regulating, and the voltage necessary on the line, the line losses, etc., in order to obtain the best working conditions. This is followed by two chapters on the methods of determining step-up and step-down transformers for long-distance transmission, including a discussion and application of the two-phase and three-phase transformer system.

On the subject of alternating current wiring and town lighting in general there is much of value to the station manager. Mr. Emmet lays particular stress upon the necessity for maintaining an equalized potential throughout the system, and shows that this can best be obtained by employing secondary mains fed by large transformers, instead of employing a large number of small transformers. As it is frequently necessary to run alternating conductors in ducts and iron conduits the author has introduced a number of chapters devoted to this subject, showing the manner of running such circuits without incurring the loss due to the presence of the iron in the ducts.

The effects of capacity, so important in long distance work, have here received special attention and practical examples show how this factor must be allowed for. Both in this case and in the other determinations in the work, the author always employs two methods, the graphical and the arithmetical. Neither of these involves the employment of mathematical formula, and while the former may be found more convenient in the hands of some, the simple arithmetical method can be applied by any one having a common school education. The tables in the work give the induction factor, power factor at different lag angles, and the inductive resistance and impedances at different frequencies, and the capacity of lead covered cables and of overhead lines.

The intelligent application of the principles contained in this little work, will save the electrical engineer and station manager, not only considerable money, but much annoyance. The questions here discussed are the most important now before the electrical community, and the author's wide practical experience in this field gives his work a special value at this time.

American Street Railway Investments: a Supplement to the Street Railway Journal; Published annually for the use of Bankers, Brokers, Capitalists, Investors and Street Railway Companies. The Street Railway Publishing Co., 26 Cortlandt St., New York. 216 pages, including 24 maps. Cloth. Price \$5.00.

This is a most interesting, useful and valuable statistical work, compiled with much diligence and intelligence, and arranged in a manner that makes reference and comparison very easy. Not only is the fullest possible information given as to the financial status of the street railways of the country, but each section furnishes data as to the population of the place, its industries, its peculiarities, its rate of valuation, debt, taxation, etc., and other points likely to determine the value of a property operated under municipal franchise. In many instances the company's last balance sheet is presented.

Two things stand out in this admirable volume, viz., the extent to which electricity has superseded other means of locomotion on street railways and the manner in which, in too many places, its introduction has been employed as a means of over capitalization. On the whole, the industry presents itself here as one of special promise for the employment of capital judiciously invested.

Electricity One Hundred Years Ago and To-day.—With copious Notes and Extracts. By Edwin J. Houston, Ph.D., New York. The W. J. Johnston Company, Ltd., 253 Broadway. 199 pages. Illus. Price \$1.00.

This is a most interesting little volume, in which Prof. Houston has taken as foundation an excellent lecture and embellished it with all manner of references to quaint and out-of-the-way lore. It sets several things right, and raises so many questions about the origin of various electrical ideas and invention that one would really like to see the probe of inquiry driven deeper yet. It is evident from the perusal of such a work as this, that a good deal of accepted electrical history will have to be rewritten. Prof. Houston's volume, as a *memoir pour servir* and as a review of the art is most welcome.

LEGAL NOTES.

EDISON ELECTRIC LIGHT COMPANY ET AL. vs. THE CITIZENS' ELECTRIC LIGHT, HEAT AND POWER COMPANY, OF LANCASTER, PA.—JUDGE DALLAS' OPINION.

WE give below, in full, the opinion of Judge Dallas in the above case, brief mention of which was made in our issue of last week:

DALLAS, Cir. J.—This is a motion for a preliminary injunction to restrain the defendant from using certain electric lamps in alleged violation of the rights of the complainants under what is known as the Edison patent for incandescent lamps. The substantial question is as to the weight which should, upon this application, be accorded to the action of the Circuit Court for the Northern District of Ohio, on certain motions made in that Court, for, and to dissolve, preliminary injunctions in suits upon the same patent. In disposing of the motions referred to, Judge Ricks delivered three opinions, which have been discussed at length by counsel, and attentively read by me; but I do not deem it necessary or advisable to express any opinion of my own upon the subjects with which they deal. It is enough to say that he has decided that the lamps now involved could be lawfully made and sold by the defendant's vendor; and under *Adams v. Burke* (17 Wall., 453), and *Hobbie v. Jennison* (149 U. S., 361), the user of a patented article is not liable as an infringer, where he purchased it of a person who had a legal right to sell it. Nothing is now indicated as to the view which may be taken of this case when considered upon pleadings and proofs, but I am of opinion that, because a preliminary injunction against the maker of these lamps has been refused in the Sixth Circuit, this Court should not, upon interlocutory application, enjoin the use of them by a defendant who bought them from that maker.

The motion for a preliminary injunction is denied.

PERSONAL.

CREHORE-BUCK.

ON July 10 Prof. Albert C. Crehore, of Dartmouth College, was married to Miss Sara H. Buck, at Brooklyn, N. Y. The couple will spend their honeymoon in the White Mountains and will make their home at Hanover, N. H., the seat of Dartmouth.

MR. WILLIAM H. BROWNE, who has lately resigned his position as General Manager for the United Electric Light and Power Company, New York, has just been appointed receiver for the Flushing, Long Island, Railway Company. Mr. Browne's experience for the past six years makes him specially fitted for this position.

COL. WHEELWRIGHT, chairman of the Massachusetts Gas and Electric Light Commission has resigned, on account of the new law which requires that the Commissioners shall attend to no other business.

ELECTRIC LIGHTS IN BATTLE.

A SPECIAL dispatch from Germany says, at the coming manoeuvres near Elbing, Emperor William will command, in the presence of the Czarewitch, a grand cavalry attack by night. All the latest military inventions will be used in this attack. Balloons with electric search lights will illuminate the field, and small electric lights will be attached to the lances of the cavalry.

ELECTRIC LIGHTING IN GLASGOW.

THE Corporation Electric Light Supply service at Glasgow, Scotland, now has 382 customers, who had taken and applied for a total capacity of 46,466 lamps of 8 c. p. Mr. W. Arnot is the electrical engineer to the corporation of Glasgow, and has charge of the plant.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS
ISSUED JULY 3, 1894.**Accumulators:—**

Electrode for Secondary Batteries, W. Morrison, Des Moines, Iowa, 522,479. Filed April 25, 1892.
Consists of a number of lead ribbons folded against each other and having spaces within the folds to provide for the thickening of the ribbons by the expansion of the lead.

Alarms and Signals:—

Auxiliary Fire Alarm Signal System, J. Sachs, New York, N. Y., 522,231; Filed Nov. 8, 1892.
A fire alarm signal in which the street boxes can be released or operated by means of one or more auxiliary circuits at a distance from the street boxes.
Window Spring for Burglar Alarms, J. Steiner, Brooklyn, N. Y., 522,577. Filed Nov. 4, 1892.
Automatic Fire Alarm, C. A. Mann, Buffalo, N. Y., 522,346. Filed March 16, 1894.
Electric Alarm Signal for Railway Crossings, J. J. Ross, Detroit, Mich., 522,431. Filed April 17, 1894.
Torpedo Machine or Apparatus for Railway Signaling, J. W. Lattig, Easton, Pa., 522,473. Filed Feb. 15, 1894.
Electric Torpedo Apparatus and System for Railway Signaling, J. W. Lattig, Easton, Pa., 522,523. Filed Feb. 27, 1894.

Conductors, Conduits and Insulators:—

Process of Manufacturing Insulating Material, A. F. Tinnerholm and C. F. Peterson, Schenectady, N. Y., 522,242. Filed July 31, 1893.
Process consists of adding powdered gum or resin to scales of mica and forming the whole into a solid sheet by pressure.
Self-Locking Cleat for Electric Wires, E. Nashold, Chicago, Ill., 522,302. Filed Feb. 24, 1894.
A block having grooves extending obliquely across the surface and terminating in flaring openings at each side of the block, the apexes of the openings being substantially in a direct line across the cleat.
Insulator, E. Mace, New York, 522,428. Filed May 3, 1894.
A tubular insulator with a lateral extension near one end, to secure it to the support through which it extends.

Distribution:—

Distributing Board for Electric Currents, R. Herman, Crafton, Pa., 522,370. Filed Dec. 14, 1893.
So constructed that the main and distributing wires may be readily attached to their terminals, and the distributing circuits in any desired number connected to the terminals of the main circuit by fuse strips.

Dynamos and Motors:—

Alternating Current Dynamo Electric Machine, E. Thomson, Swampscott, Mass., 522,341. Filed Oct. 21, 1893.
Claim 1 follows:—
The method of varying the periodicity of an electric current, which consists in successively and continuously changing the points of line connection in either direction around a rotating commutator independently of its own rotation.
Dynamo Electric Machine, C. E. Scribner, Chicago, Ill., 522,374. Filed June 1, 1893.
Employs pole pieces having their cores so wound and connected that the short-circuited coils will have a field of force of the required strength, maintained practically constant, while the field of force of the current-giving coils will be automatically varied to vary the E. M. F. of the machine.
Regulator for Dynamo Electric Machines, C. E. Scribner, Chicago, Ill., 522,375. Filed Oct. 14, 1893.
Invention consists in the combination with a dash pot connected with the brush carrier and tending to move the brushes in a given direction, of a motor in the main circuit adapted to move the brush carrier in the opposite direction against the resistance of the dash pot.
Dynamo Electric Machine or Motor, C. S. Bradley, Avon, N. Y., 522,286. Filed Oct. 26, 1893.
Employs a plurality of armature circuits, independent commutator brushes for each circuit, and connections coupling the several pairs of brushes in series relation; the connection between an intermediate pair of brushes including the field magnet circuit and being electrically connected with the frame.
Alternating Current Motor, J. F. Kelly, Pittsfield, Mass., 522,344. Filed Feb. 25, 1894.
Claim 1 follows:—
An alternating current motor consisting of an inducing system having, when energized by an alternating current, an asymmetrical single phase alternating magnetic field in combination with a closed symmetrical induced system, the two systems being relatively movable.
Method of Producing Continuous Motion by Alternating Currents, J. F. Kelly, Pittsfield, Mass., 522,345. Filed Feb. 26, 1894.
Method consists in producing by an alternating current inducing system a single phase alternating asymmetrical magnetic field, and by such field, inducing a current in a closed conducting system.
Alternating Current Motor, W. Stanley, Jr., Pittsfield, Mass., 522,356. Filed April 2, 1894.
Consists of a field magnet in which the magneto motive force is asymmetrical and of uniform phase, and a conducting system symmetrical about an axis around which one of the members is free to rotate.

Galvanic and Thermo-Electric Batteries:—

Galvanic Battery, F. Fullner, Chicago, Ill., 522,559. Filed Aug. 28, 1893.
Consists of a zinc element in a solution of potash, and a carbon element in a porous cup containing a solution of sulphuric acid and nitrate of soda, the proportions of the solutions being definitely specified.

Lamps and Apparatuses:—

Electric Arc Lamp, A. Schweitzer, Allegheny, Pa., 522,233. Filed Dec. 28, 1893.
A gravity feed arc lamp employing curved carbons adapted to move in the arc of a circle.
Electric Arc Lamp, A. W. Smith, San Francisco, Cal., 522,276. Filed April 2, 1894.
Relates to certain mechanical details of construction intended to simplify the feeding mechanism of the lamp.
Electric Arc Lamp, E. & F. W. Heymann, Boston, Mass., 522,291. Filed April 14, 1893.
Relates to the special construction of the parts, whereby the mechanism is made compact for the purpose of materially encasing the lamp frame.
Electric Arc Lamp, J. F. Kester, Buffalo, N. Y., 522,327. Filed Nov. 23, 1893.

Provides means whereby the leverage between the magnet and the feed mechanism can be varied so that a current of larger or smaller volume or quantity can be used in connection with the lamp.

Metal Working:—

Electric Converter, G. D. Burton, Boston, Mass., and E. E. Angell, Somerville, Mass., 522,506. Filed Nov. 14, 1892.
Consists of two connected standards of magnetic material supporting in eyes at their upper end a core, upon which the primary and secondary coils are wound. Adapted specially for metal working purposes.
Electric Converter, G. D. Burton, Boston, Mass., and E. E. Angell, Somerville, Mass., 522,507. Filed Nov. 20, 1892.
A converter to which a number of electric forges may be connected in parallel with means for regulating the secondary current either jointly or independently of each other.

Miscellaneous:—

Organ, R. Hope-Jones, Birkenhead, England, 522,309. Filed Sept. 18, 1891.
Relates to an electric system for combining, varying and controlling the tones of the various pipes, reeds, bells, etc. of organs and similar instruments.

Railways and Appliances:—

Electric Railway Car Truck, F. O. Blackwell, Lynn, Mass., 522,189. Filed May 1, 1891.
Relates to a flexible coupling connecting the motor shaft with the gearing on the axle.
Rail Joint and Bond for Electric Railways, J. Meyer, New York, N. Y., 522,349. Filed Oct. 21, 1893.
Employs a trough connecting the ends of the rails and adapted to contain the bond wire and a filling of asphalt.
Suspension Clip for Trolley Wires, W. F. D. Crane, East Orange, N. J., 522,362. Filed March 10, 1894.
Electric Railway Supply Circuit, R. M. Hunter, Philadelphia, Pa., 522,374. Filed May 8, 1894.
Has for its object to feed the working circuits of railways distant from the central station through circuits arranged parallel to railways leading to or near the central station and arranged transversely to the first mentioned railways.
Electric Railway Switch and Trolley, F. S. Perrin, Lynn, Mass., 522,388. Filed March 12, 1892.
Employs switches in the trolley wire by which the wheel may be diverted to a branch trolley wire; the switch being under the control of the operator of the car.
Conduit Electric Railway, J. H. Tyrrell, New York, N. Y., 522,440. Filed Jan. 23, 1894.
Employs a metallic supporting tube for the line wire within the conduit filled with insulating material from which one side of the line wire projects.
Electric Railway Conduit, A. T. Fay, Minneapolis, Minn., 522,460. Filed April 15, 1892.
A simple form of conduit built up upon the wooden ties which also support the rails, and having a longitudinal trough below the ties adapted to carry off water, mud, etc., that may enter the slot.
Conduit for Trolley Arms, A. T. Fay, Minneapolis, Minn., 522,461. Filed July 26, 1892.
Similar to 522,460.

Switches and Out-lets:—

Electric Safety Fuse, J. Sachs, New York, N. Y., 522,232. Filed April 10, 1893.
Employs a material such as silicic acid surrounding the fuse and adapted to combine with the metal when the fuse is melted and form a non-conductor.
Electric Switch, J. Van Vleck, New York, N. Y., 522,332. Filed May 28, 1894.
A snap switch for the three-wire system having three circuit-closing plates and three pairs of contact fingers; the fingers connected to the neutral conductor being of such length that the circuit shall be closed through the neutral before the positive or negative.
Electric Automatic Circuit Breaker, O. W. Larson, Lynn, Mass., 522,527. Filed Oct. 17, 1893.
An automatic circuit-breaker operated by an electromagnet and its armature and adapted to prevent the overloading of motors.

Telegraphs:—

Machine for Teaching Telegraphy, T. M. Crepar, Clare, Mich., 522,454. Filed March 20, 1894.
Telegraph Repeater, A. D. P. Weaver, Jackson, Miss., 522,500. Filed Dec. 26, 1893.

Telephones and Apparatus:—

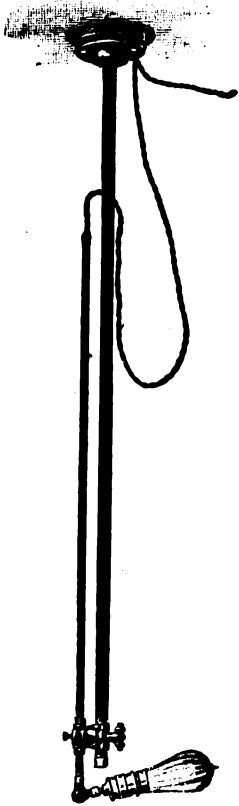
Telephone Transmitter, W. R. Cole, Detroit, Mich., 522,404. Filed April 30, 1894.
Employs a transmitting diaphragm causing variations of contact between electrodes of a transmitting circuit, one of the electrodes being held in contact with the diaphragm by a spring and the other electrode held in contact with the first.
Multiple Telephony, M. Hulin and M. Loblanc, Paris, France, 522,561. Filed June 1, 1894.
Claim 1 follows:—
The improvement in the art of telephony, which consists in transmitting vocal or other sounds by generating electrical undulations similar in form to the sound waves, and selecting therefrom and energizing a line with components of these electrical undulations.

SALES OF M. A. GREEN AUTOMATIC ENGINES.

THE ALTOONA MANUFACTURING COMPANY, of Altoona, Pa., builders of the improved M. A. Green automatic cut-off engines, reports the following orders received during June: One 280 H. P. engine for the Akron Street Railway Co., of Akron, O., to be direct coupled to a 250 H. P. generator built by the Walker Manufacturing Co., of Cleveland, O.; one 150 H. P. enclosed type self-oiling engine for the Watson Mining and Mfg. Co., of Monongahela City, Pa., for an electric mining and haulage plant; one 65 H. P. enclosed type self-oiling engine for the Lyceum Theatre, Philadelphia; one 175 H. P. Standard centre crank engine for the Freeport Electric Railway Co., of Freeport, Ill.; one 65 H. P. enclosed type self-oiling engine for Knight Brothers, Fayette, Iowa. There is also considerable inquiry and with a settlement of the railroad strike it is believed that a substantial improvement in business will result.

Trade Notes and Novelties AND MECHANICAL DEPARTMENT.

THE WHITE ADJUSTABLE HOLDER FOR INCANDESCENT LIGHTS.



White Adjustable Lamp Holder.

ONE great drawback to the use of incandescent lamps in factories, mills, draughting rooms, banks, offices, etc., where a movable light is both a convenience and a necessity, has been removed by an invention which the O. C. White Co., of Worcester, Mass., have recently placed on the market. It does away with the old method of sustaining the lamp by the service wires and, by means of a combination of tubes and joints corresponding closely to those in the human arm, the lamp may be shifted into any desired position and held there adjustably.

The foundation is a sectional ball and socket joint on a base suited to any required position, either the ceiling, wall, floor, column or corner being available. This joint has received many awards and medals for its remarkable originality and great value, especially from the Franklin Institute, of Philadelphia, and the Massachusetts Charitable Mechanics Association, of Boston. From this joint runs a tube of firm metal to a swivel joint which carries another metal tube, usually shorter than the first. This joint allows of extension and rotation of the arms in any direction. The conducting wires pass through the short arm, which at its far end carries the lamp, by a third joint, which allows the lamp to be inclined at any angle. All one has to do is to put the lamp where it is required and it stays there without any further attention whatever.

Every joint of the mechanism has an elastic pressure, easily adjusted if necessary, which is sufficient to hold a heavy lamp and shade quite firmly, and still yield to a moderate force when it is desired to change its position.

All the working parts are of metal, made interchangeable; insulating bushings protect the conducting cords and ample provision is made for any possible wear by prolonged use.

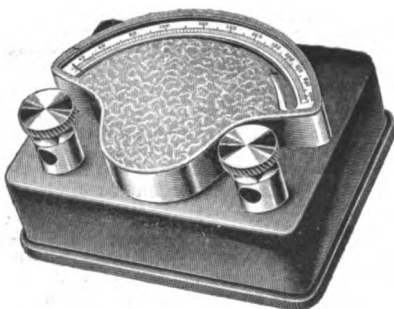
The variety of form as well as the range of motion of these holders is almost unlimited.

For the holders and the component joints, the highest awards were given at the Columbian Exposition at Chicago.

These adjustable holders are made by the O. C. White Co., of Worcester, Mass.

PORTABLE ALTERNATING CURRENT METER.

A portable instrument by means of which accurate measurements may be made of alternating currents is now being placed



GENERAL ELECTRIC PORTABLE ALTERNATING CURRENT METER.

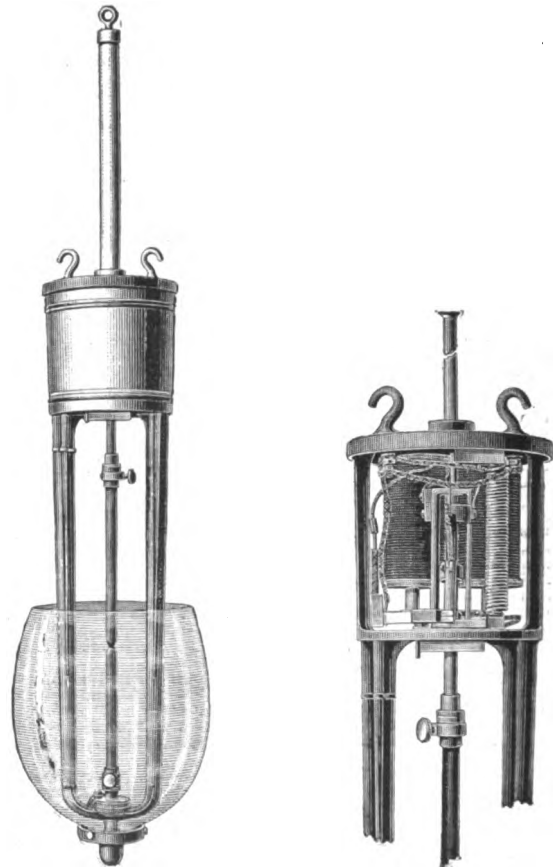
upon the market by the General Electric Company. It is small and handy and combines strength, permanency and reliability with compactness of form and excellence of workmanship. The scale is unusually long and reads to fine divisions. The instrument,

although designed for alternating current measurements, may also be used for measuring direct currents, but for this work it requires special calibration. It is made in 25, 50, 100 and 200 ampere sizes.

THE RUSHMORE CONSTANT CURRENT ARC LAMP.

THIS lamp is designed to meet the requirements of a simple and durable lamp for street lighting on constant current or arc dynamo. Its great value lies in its extreme simplicity and solid construction, together with the perfect clutch feed mechanism, that works perfectly, even after very long use.

While the lamp contains a number of new features, that will be fully protected, its most valuable qualities are due to the careful design and the proper adaptation of devices that years of service have shown to be the best. The entire lamp frame, as shown in



FIGS. 1 AND 2.—RUSHMORE CONSTANT CURRENT ARC LAMP.

Fig. 1, is a single casting and the feed clutch, Fig. 2, is very simple; the electrical control of the feed is so powerful that it is not at all necessary to have the clutch in the best condition for an even feed.

One of the greatest troubles with clutch lamps is the uneven wearing of the rod and in this lamp the rod is made of phosphor bronze, ensuring a much longer wear. The lamp has a positive cut-out that forms a part of the feeding mechanism, and when the carbons are consumed the lamp is automatically short circuited in addition to the regular cut-out, so that there is no chance of an open circuit occurring on the line.

This lamp is made to burn 14 hours on any constant current circuit. It has a hand switch, is entirely waterproof and is very neat in appearance for interior lighting.

THE NATIONAL CONDUIT MFG. CO.

THE National Conduit Mfg. Co., of the Times Building, New York city, has just closed its seventh consecutive annual contract with the New England Telephone Co. for the entire subway work for the latter corporation. This fact speaks more conclusively than several pages of reading matter could for the excellence of the National cement lined conduit. More than 1,500,000 feet of this conduit is now in use throughout New England, and 400,000 feet has been laid for the Philadelphia Traction Company within the last 18 months.

The company has recently entered suit against E. H. Phipps and the Connecticut Pipe Mfg. Co., of New Haven, Conn., for infringement of its patent upon cement lined conduit.

HIGH ECONOMY INCANDESCENT LAMPS.

AFTER a series of exhaustive experiments, covering several months, under the supervision of Mr. J. E. Randall, the Columbia Incandescent Lamp Company announces that it is prepared to furnish to its customers a superior lamp of high efficiency for 100, 110 volts, etc., circuits.

The filament is made by an entirely new process which results in very uniform production and also in the manufacture of lamps having a much higher economy than those of the same voltage heretofore placed on the market. It is claimed that a comparative test of these lamps with those of other makes, shows that they will maintain their candle power to a higher degree at a higher efficiency than any other lamps heretofore placed on the market. While the filament is made in coiled form on account of its extreme length, this is not the special feature of the lamp, but the material from which the filament is made, making it more homogeneous and uniform in results.

The use of this lamp, it is claimed, will show a saving to the consumer in energy of from 15 to 20 per cent. and a corresponding increased output to the station capacity.

The recent decision of Judge Dallas in the case of the Edison Electric Light Co. vs. the Citizens' Light, Heat and Power Co., of Lancaster, Pa., on page 56 of this issue, leaves the Columbia Company in a position to protect its customers. Judge Dallas, it will be noted, did not pass on the facts in the case, but held that the user of a patented article is not liable as an infringer, when he purchases it of the person who had a legal right to sell it; and held further: "But I am of opinion that, because a preliminary injunction against the maker of these lamps has been refused in the Sixth Circuit, this Court should not, upon interlocutory application, enjoin the use of them by a defendant who bought them from that maker." This would clearly seem to cover the case of the Columbia Incandescent Lamp Co. as well, for they evidently have a legal right to manufacture and sell lamps, a preliminary injunction having been refused as against them.

NEW CATALOGUE OF THE ELECTRIC STORAGE BATTERY CO.

THE ELECTRIC STORAGE BATTERY CO., of the Drexel Building, Philadelphia, have just issued a valuable catalogue descriptive of their accumulators, full descriptions of which have appeared in the pages of THE ELECTRICAL ENGINEER. Particular attention is called to the large number of central station accumulator plants now in successful operation in Europe, and to the advantages of such practice, and an interesting illustrated description of such a plant installed by this company for the Germantown Electric Light Company, of Philadelphia, is given. The Chloride accumulator for traction work forms the subject of one chapter, and statistics are given, showing the satisfactory work accomplished by these cells in this most exacting field.

In order to supply an increasing demand, the company is manufacturing two new types of cell, known as Types "C" and "D," the latter being of half the capacity of Type "E," the smallest formerly made, and the former having only half the capacity of Type "D." Thus, Type "C" is composed of 8, 5 or 7 plates 4 inches square, and has a normal useful capacity of 12½, 25 or 37½ ampere hours respectively. The weight of each element is 4¼, 7 or 10 pounds, according to the number of plates. In type "D" the plates are 6 inches square and the elements are made of all the odd numbers from 3 to 13. The useful capacity ranges from 25 to 150 ampere hours and the weight per element from 7½ to 33½ pounds. These smaller types have, we understand, deservedly met with a large demand.

Eleven pages of the catalogue are taken up with testimonials from men and concerns whose names are well known in the electrical and commercial world. Among them may be mentioned, Samuel R. Shipley, president of the Provident Life and Trust Company, of Philadelphia; Chas. M. Allen, superintendent of the Germantown Electric Light Co., of Philadelphia; Prof. Houston; Mr. Kennelly; Prof. Chandler, of Columbia; Prof. Hastings, of Yale; Prof. Barker, of the University of Pennsylvania; and a number of others.

THE TRIUMPH ELECTRIC CO.

THE TRIUMPH ELECTRIC CO., of Cincinnati, Ohio, have issued a circular calling attention to the method they have adopted in order to place their machines on the market at an exceedingly low price. To quote their own words:

"We make a straight-forward business proposition to cut off selling expense, salary expense, and offer the saving to you in low prices. In return we expect you to send us your orders without our going for them—in short, do your buying and our selling. From this method, when understood, we effect such a volume of business, that though the profit may be small on any one order, the aggregate result will be a fair return upon our investment."

The Triumph dynamos and motors have a short magnetic circuit, the field magnets are made without joint and the armature is magnetically enclosed. This last feature is said to be peculiar

to this make. The brushes are of carbon set in immovable holders, and the self oiling bearings hold a month's supply of oil. All parts are carefully made and the machines are easy to operate, do not heat when running, and are very strong and durable.

Accompanying the circular is a long list of users of the Triumph machines, and a file of fac-simile testimonial letters.

EARNINGS OF THE NEW YORK EDISON CO.

We give below a comparative statement of the earnings of the Edison Electric Illuminating Co., of New York, for the month of June and for the six months ending with June 30, of the years 1893 and 1894, respectively.

	JUNE.	
	1894.	1893.
Gross.....	101,351.25	85,611.17
Net.....	52,504.20	84,197.89
		15,740.08 Inc.
		18,306.81 Inc.
	SIX MONTHS.	
Gross.....	687,754.60	609,855.15
Net.....	375,644.68	282,302.78
		77,899.45 Inc.
		98,841.90 Inc.

THE BROADWAY CABLE SIGNAL SYSTEM, NEW YORK.

THE new signal system of the Broadway cable road is working successfully. At intervals of two or three blocks and close beside the rails will be noticed a square iron cover with a hole in the centre. When an accident happens this cover is raised, and a board with a hook and a button is disclosed. One pull signifies "Stop cable;" two pulls, "Start cable;" three pulls, "Wagon with tools;" four pulls, "Fire blocks the line;" five pulls, "Tension off;" six pulls, "Tension on;" seven pulls, "Telephone;" and eight pulls, "Test." The signals are transmitted to the power stations and to the President's office at Broadway and Houston street. Every employee of the road is provided with a book of rules, in which are printed the necessary instructions and the location of the signal stations. The construction of this system was begun many months ago but the Electrical Subway Company brought suit claiming that it was an infringement on that corporation's exclusive franchise. This suit was decided in favor of the railroad company a few weeks ago.

EFFECT OF TELEGRAPHY ON WOMEN OPERATORS.

PROF. EWALD, in a recent lecture at Berlin, declared that nervous diseases are very common among female telegraphers, and expressed the opinion that such employment is not suited for women. There may be some foundation for this view in Germany, where the women operators may have long hours and small pay, under severe discipline, but in America telegraphy has apparently proved a most congenial occupation for women. In this city the Western Union employs about 200 women in its city department with very satisfactory results, and the Postal Co. has also a large number of women operators. A visit to both offices confirms the idea that the employment is in reality healthy and beneficial, and far more so than teaching or standing long hours in stores. The New York Sun has interviewed some of the women on the subject, including Miss M. E. Randolph, a well-known expert telegrapher and an accomplished woman, and her opinion is very favorable to telegraphy as a means of livelihood for those of her sex.

KILLING RATS BY ELECTRICITY IN PHILADELPHIA.

A HORDE of sewer rats, which pestered a down-town restaurant keeper, says the Philadelphia Record, have been decimated by an ingenious electrician. The rodents came up day after day through a hole alongside a grated covering of a sewer inlet in the yard back of the restaurant. The electrician offered to construct an effective trap and the restaurateur told him to go ahead. He laid coils of copper wire about the hole and made an attachment to the electric light wires within the building, supplying a key to turn on the current. A watch was kept on the hole, and when a dozen rats were playing about the yard the key was turned. As the rats returned, one by one, to their hole they keeled over dead. In this novel way nearly 100 rats have been killed off in a little over a week.

TO PREVENT COLLISIONS AT SEA BY SEARCHLIGHT.

LIEUT. F. BOYER of the French navy, to avoid collisions, proposes to place on all fast sailing steamers an electric light, which will cast a beam ahead to indicate the direction in which the vessel is steering. So long as the approaching ship is not in the actual pencil of light it will be unnecessary for her to alter her course.

NEW TELEPHONE ENTERPRISE IN PHILADELPHIA.

THE MUTUAL AUTOMATIC TELEPHONE Co., of Philadelphia, Wm. H. Eckert, President (formerly General Superintendent of the Metropolitan Telephone & Telegraph Company, New York), gave an exhibition of its apparatus at the company's office, Bullitt building, last week. Mr. Eckert said that his company had obtained, under ordinance of councils, approved by the mayor, authority to cover the entire city of Philadelphia by their automatic system. The Strowger automatic exchange system will be employed.

PACKARD MOGUL LAMP.

The demand for the Packard Mogul Lamp adapted particularly for outside work has induced the factory to make arrangements to furnish a special street hood particularly designed for the Mogul lamp so that it can be used safely and conveniently for outside work, and the Electric Appliance Company hope to have some of the new street fixtures on exhibition in their Chicago salesrooms in the course of a few days. Although originally intended for inside work the Packard Mogul seems to be filling even a larger field than the manufacturers had hoped and in addition to being extensively used for large interior lighting, is coming into quite general use for outside work, its advantages for alternating current circuits being readily apparent.

THE "ACME" PORTABLE VOLTMETER.

QUEEN & Co. of Philadelphia, have for months past held back from the market a new type of portable voltmeter for both alternating and direct current circuits, in order to give it a thorough time test. They are now satisfied that the instrument is thoroughly adapted to laboratory as well as station measurements and are preparing to manufacture it in sufficient quantities to meet the large demand which seems assured, so soon as the merits of the voltmeter become known. It operates on the "hot-wire" principle and is absolutely free from hysteresis error, thus being correct for alternating circuits of any frequency. It is dead-beat without a mechanical brake—a most important feature—and is claimed to be the most compact and reliable instrument of its class made. Twenty different ranges cover potentials from two volts to three thousand and by means of a special interchangeable adaptor which fits the Edison, Thomson-Houston or Westinghouse systems, measurements can be made very rapidly.

The "Acme" voltmeter received the highest World's Fair award because "it possesses high sensibility over the entire scale and its zero is not affected by changes of temperature. The instrument is unusually compact and portable." The apparatus was fully described in an extended article in THE ELECTRICAL ENGINEER for February 28, 1894, entitled "The 'Acme' Standard Voltmeters for Direct and Alternating Circuits."

WESTERN NOTES.

DR. LOUIS BELL is now at the Chicago offices of the General Electric Company.

ELKHART, IND.—The Hornberger Electric Manufacturing Co. report a gratifying increase in orders for the Elkhart transformers, in spite of the dull times. They are making active preparations to take care of the increase in business which they say is bound to come.

THE HARRISON INTERNATIONAL TELEPHONE CONSTRUCTION Company will move their general offices to the Chamber of Commerce Building, Chicago, this week, the general offices of The Harrison International Telephone Company remaining here. This change is made imperative owing to the growth of their Western business. We regret to announce that the company's treasurer, Mr. James E. McElroy, head of the firm of James E. McElroy & Co. died suddenly on June 30. He will be succeeded by his brother, Mr. Robert L. McElroy, who is also a member of the above named firm, and who is the resident partner in Chicago. There will not be any other changes in the management of the corporation.

THE RACINE HARDWARE COMPANY, Racine, Wis., have just issued a neatly gotten up catalogue illustrating and describing the Racine automatic engines, Racine safety boiler, stationary boilers, etc. The engines as now built contain all the latest improvements and are probably as nearly perfect as an engine of that kind can be made. Each engine, before leaving the works, is thoroughly tested and inspected. The company employ only competent and experienced workmen, and by the use of the best machinery and a perfect system of jigs and templates, are enabled to furnish an "up to date" engine at a moderate price. Besides a complete description of the engine and its various parts, the pamphlet contains descriptions of other specialties made by the company. Mr. W. F. Parish is the General Sales Manager and will at all times be glad to give full particulars, prices, etc.

NORTHWESTERN ELECTRICAL ASSOCIATION.—We give elsewhere in this issue the details of the arrangements for transportation of members and others who contemplate attending the meeting of this Association at St. Paul, on July 18-20. The line selected, the Wisconsin Central, is one of the most pleasant and attractive routes to go over. It is the short and direct line to all points in northern, middle, western and eastern Wisconsin, taking in all the prominent summer resorts of the Northwest, chief among which are Waukesha, Ashland, Waupaca, Cedar Lake, Lake Winnebago District, Lake Beulah, Silver Lake, etc. At St. Paul this line connects with the Great Northern Railway, the direct line to the great Northwest and the Pacific Coast.

ALL users of colored and frosted incandescent lamps have, undoubtedly, frequently suffered considerable inconvenience from inability to get their orders for fancy goods filled promptly from stock. The Electric Appliance Company, appreciating the fact that some arrangement ought to be made by which delays of this kind could be obviated, have perfected plans for frosting and coloring lamps of all kinds in Chicago and have established a coloring room for doing this work and are prepared to furnish colored and frosted lamps promptly on receipt of orders. By the use of improved coloring compounds and methods of treating, results have been secured in colored and frosted lamps fully equalling those obtained from genuine colored and frosted glass and, of course, at a very much less cost. Customers will undoubtedly show their appreciation of prompt delivery on these goods.

NEW YORK NOTES.

THE UNITED STATES PROJECTILE CO., at Brooklyn, N. Y., are making extensive additions to their machine shop, and have placed the contract for this work with the Berlin Iron Bridge Co., of East Berlin, Conn.

THE UNITED ELECTRIC LIGHT, HEAT AND POWER CO., of New York City, are putting up a new switchboard building which will be covered with an iron roof and the Berlin Iron Bridge Company's patent anti-condensation corrugated iron roof covering.

At the annual meeting of the Brush Electric Illuminating Co., of New York, just held, the following officers were elected: C. J. Canda, president; C. J. Marsh, secretary and treasurer. Wm. Wright, general superintendent. A number of changes in the administrative and technical departments of the company have been effected.

THE UNITED STATES HEAD-LIGHT CO. announce that they have made arrangements with I. A. Williams & Co., Utica, N. Y., and Chicago, Ill., to act as one of their agents for the sale of their locomotive, electric, cable and motor car, and other head-lights, and feel justified in assuring the trade that all orders and correspondence with which they may be favored regarding the same will be given that prompt and careful attention for which this long established and well-known firm is noted.

Messrs. Williams & Co. will carry a full line of standard styles from which orders can be filled with dispatch.

PHILADELPHIA NOTES.

MESSRS. T. T. BURCHFIELD & Co., of Philadelphia, eastern representatives for the M. A. Green automatic engine have just finished and started the electric railway plant at Pottstown, Pa., which consists of two 150 H. P. boilers, two 150 H. P. M. A. Green improved automatic direct connected engines, with pumps, heaters, etc., completing the installation of the power plant. The engines are running very fine; on July 4 they were put to their utmost capacity and hauled in the neighborhood of 15,000 people. The company are also installing an 80 H. P. boiler and 60 H. P. M. A. Green engine in the Lyceum Theatre, No. 724 Vine St., Philadelphia.

CANADIAN NOTES.

THE CANADIAN GENERAL ELECTRIC CO. has closed a contract through Mr. W. F. Dean, its agent for the Province of Quebec, with La Compagnie des Pouvoirs Hydrauliques de St. Hyacinthe, for two 175 K. W. three-phase generators. This will be the first polyphase plant in Canada and is to be in operation about the first of next October. The generators are to be driven by water power and current for lighting and power is to be transmitted at 2,500 volts to the town of St. Hyacinthe, a distance of about five miles.

Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE

Electrical Engineer.

Vol. XVIII.

JULY 25, 1894.

No. 325.

GAS ENGINES AND ELECTRIC TRANSMISSION FROM THE COAL MINES.

BY



I NOTE with satisfaction, in THE ELECTRICAL ENGINEER of July 4, your proposition in regard to power transmission at the Paris Exposition of 1900, wherein you state that among the most pressing problems of the day are those relating to electric transmission of energy; and your further comments on the utilization of the culm piles in the coal districts, in your last issue.

As far as regards the transmission from water-falls, we are upon, we may say, the threshold, for although there has not as yet been any very great showing either here or in Europe, but little more time is required to demonstrate the actual possibilities. But even water-falls are not so very plentiful, nor are they as a rule to be depended upon, being subject to the elements to a very great extent, with troublesome rights to be taken care of, bringing in sometimes a constant expenditure not taken into consideration when the subject first looms up, to say nothing of large initial expenditure for damming, conveying, etc.; therefore, when the transmission of electrical energy is fully demonstrated, all other sources of primary energy, far distant from where it could be most advantageously used, will eventually be utilized in the same manner.

Take the products of coal mines, to say nothing of the large deposits of culm, mine refuse, shale oil dumps, etc., and use them where they originate, not to generate steam even, but to be turned directly into gas, for initial power purposes, thus further increasing the value also, of what is now left as waste, as well as the amount of power obtainable over any other method yet in practice from the same amount of fuel.

To transport the fuel itself in the shape of electrical energy from the mine to the consumer is what will eventually be done, for, with the possible exception of steam vessels (and even that is not safe to predict), electrical energy has done and will do everything required better than direct fuel, not only in the factory and household but in transportation as well.

Of course the direct generating of electrical energy from fuel is what we ultimately expect to arrive at, but until then we must creep if we can't walk and get the creeping as near walking as possible. Proverbs and adages are even now changing as well as everything else; it used to be that "if the mountain would not go to Mahomet, why Mahomet would go to the mountain." Now however, we bring the mountain every time; if it won't, it will be made to. Gas engines and their first cousins, the oil engines, are naturally getting closer to walking than any other form of engine yet in practice, and would have been very much nearer it than they are, if the latest improvements during the last few years to the steam engines had not

come to the front. It is more than twenty-five years since Dr. Siemens prophesied that the days of the steam engine were numbered; why is it that this prediction of his hung fire, when almost everything else he said or did came right? Ability to carry higher steam for, and multiple expansions of, engines caused it.

But we have about reached the limit, for with much higher pressure than we use now the corresponding gain is insufficient, besides bringing entirely new conditions into play. We can hardly improve the boiler, as far as the cost of generating a pound of steam is concerned; there has hardly been any improvement in that direction for a hundred years or more; there have been, however, any number of improvements as far as regards construction, reduction of space, rapidity of steaming, strength and ability to stand pressure, but nothing to speak of in reducing the cost to operate. Therefore the boiler will, in the near future as an intermediary, have to be relegated to the lumber room as a contrivance that has outlived its usefulness, and fuel direct used in place thereof. Almost all types of apparatus for the generating of motive power have had naturally to start from small sizes, and although it may look simple enough, or only a natural sequence, that if it works well in a small scale it will work proportionately in any size, yet in developing they generally do not, but bring new troubles that have to be overcome.

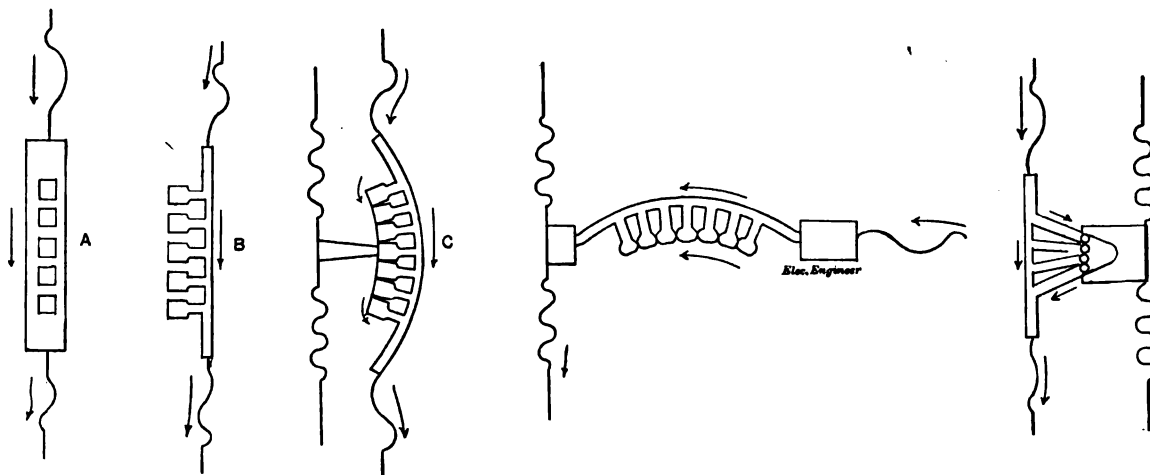
This, together with the few requirements for large units, and the necessity of new designs to safely take care of powerful explosions, or almost instantly generated power, and the seemingly small margin of gain as compared with past improvements, has prevented the use of large gas engines being more general. Gas engines have taken quite a start, however, in the last few years, and are now built of comparatively large units as well as being compounded. In Scotland this spring I was shown a compound gas engine under test, that the manufacturers were experimenting upon; it certainly worked well, regulation was almost perfect, the engine was almost noiseless, and evidently used up all the heat of the exhaust, a loss that is common to all gas and oil engines. The same firm have erected and guarantee to erect gas engines of large units, 800 H. P. and over, that will use no more than .8 of a lb. of anthracite coal per indicated horse power hour, using producer gas, and the .8 of a lb. covering everything used in the way of fuel. The superintendent of the works assured me that he expected the compounding to increase the actual power obtainable from the same amount of gas about 25 per cent.; but allowing for his enthusiasm, and other items, such as low efficiency of the gas engine, and say it only gained 10 per cent., we would still be able to get one I. H. P. for less than three-quarters of a lb. of anthracite coal, or just one-half of what the highest class of engines of large units working on steady loads now give, and without expensive batteries of boilers, condensing apparatus, etc.

In the exhibition lately held at Cambridge, England, there were exhibited over twenty different makes of oil engines (while four years ago there were only two,) some of them of the most intricate construction, while others were as simple as could be, and although one of them claimed as low as .67 of a lb. of oil per H. P., they were all at, or under 1 lb., or equal to 1 cent per brake H. P. hour, which is certainly very good for small engines, ranging

from four to ten H. P., being equal to about 6 lbs. of \$3.00 per ton coal per horse power hour.

There is one point however, in transmission of energy, that must not be overlooked, and that is the more power obtainable from a pound of coal the harder is the competition between electrical transmission and fuel transportation, for a ton of coal can be transported by a railroad doing other business at a very low cost, and when 100 tons of coal represents 250,000 horse power hours, with gas engine work at .8 lb., then 100 tons transported, say 100 miles in ten hours, leaving out handling at the ends, is a

of the resistance piece, along which the variable contact shunting projections are arranged. Obviously, the resistance will be greatest when the circuit is completed only through the base of the resistance piece. For, if the projections are brought in contact there is then established, in addition to the circuit through the base, a circuit through the contacting projections, which shunts that portion of the strip or rod that lies between the points at which these projections join the base. The resistance of the projections is preferably made considerably smaller than the resistance of the base along which they are set.



FIGS. 1, 2 AND 3.—THE COTTRELL TELEPHONE TRANSMITTER WITHOUT ELECTRODES.

very hard thing to beat, even if there are considerable advantages on the side of electrical transmission. Therefore, let me again say that your proposition regarding the Paris Exposition of 1900 and electrical transmission of energy therewith, is to the point and well taken, for it is only on occasions like Expositions that such new and radical departures can be brought not only to public attention, but inside the domain of commercial possibility.

THE COTTRELL TELEPHONE TRANSMITTER WITHOUT ELECTRODES.

A novel resistance piece for telephonic transmitters has been patented recently by Herbert Cottrell of Newark, New Jersey. An important feature is that it is so constructed as to provide an unbroken connection through it in all conditions of the instrument, and a second connection parallel with the first, which latter is opened and closed or varied in resistance by vibrations of the diaphragm of the transmitter. To do this there is provided a strip of some conducting material, as a thin strip of carbon, from which project knobs or points that are but lightly if at all in contact with each other when the strip is straight. These knobs or points are brought more or less intimately in contact through the operation of the diaphragm, either by flexure of the strip or by crowding together when pushed against the inner wall of a cone carried by the diaphragm. The flexure may be produced by pushing and pulling on a knob or point or on the rod or strip; and instead of flexure which operates to bow a flat strip the operation may be to twist a rod, around the periphery of which knobs or projections of suitable shape are arranged, preferably in a sort of spiral.

The material should be a substance of large electrical resistance, carbon or some preparation of carbon being preferable. Fig. 1 A, B and C shows the resistance piece, the arrows indicating the path of the current, in its flat and in its bowed condition. Fig. 2 shows another way of bowing the strip. Fig. 3 shows the method of camming the projections together.

No movement of the diaphragm can possibly rupture the circuit, since that is always complete through the base

of the resistance piece, along which the variable contact shunting projections are arranged. Obviously, the resistance will be greatest when the circuit is completed only through the base of the resistance piece. For, if the projections are brought in contact there is then established, in addition to the circuit through the base, a circuit through the contacting projections, which shunts that portion of the strip or rod that lies between the points at which these projections join the base. The resistance of the projections is preferably made considerably smaller than the resistance of the base along which they are set.

TRANSMITTING PICTURES BY ELECTRICITY.

BY C. FRANCIS JENKINS.

One of the most interesting subjects before scientific societies at the present time is the problem of transmitting images to a distance by electricity. I offer for what it is worth a theoretical device which may be added to the

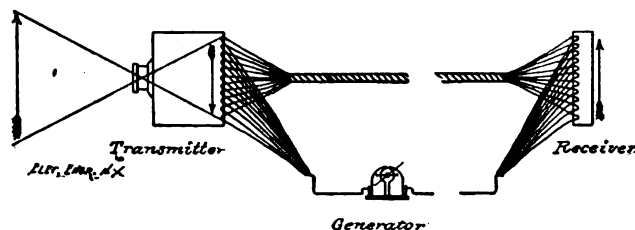


DIAGRAM OF JENKINS' PHANTOSCOPE.

methods already suggested for the accomplishment of this object. My scheme contemplates the use of selenium for a receiver, and the apparatus is substantially as follows :

A rectangular or circular non-conducting plate is set up behind a lens in such a manner as to receive the image or scene to be transmitted. This plate or board has upon its back a number of small short wires of selenium or sulphur, one end of each of which is thrust through the non-conducting board and immediately turned back, coming out again upon the same side and very near where it was

thrust through. The face of the board is covered with these little loops, one end of each of which is joined to a common conductor, the other ends having separate conductors extending over the distance intervening between the transmitting and receiving stations. At the receiving end is a large flat electric lamp of ground glass with filaments in number and position corresponding with the loops at the transmitting station—a filament for each loop and in circuit with it. We now have a number of selenium loops, each upon a separate circuit, which are affected by the light passing through the lens at the transmitting station, and in circuit with these loops, filaments in a lamp common to all the circuits. As the conductivity of each circuit is affected by the light impinging upon the selenium loop at the transmitting station each circuit carries a different quantity of the electric current generated by a dynamo in the wire common to all the circuits. The result is that all of these little filaments glow, but each with a different intensity and the light diffused over the flat surface of the ground glass lamp at the receiving station appears brighter in some parts than in others, the bright parts corresponding in position to the bright parts of the image projected upon the board by the lens at the receiving station.

The scheme, if practicable when necessary modifications are made, is objectionable in that it contemplates a multiplicity of conductors, but as a basis for study the method has its merits. I should be glad to learn of the success of such an experiment by some one, as I cannot at present test it myself.

STREET LIGHTING BY ALTERNATING ARCS.

BY

R. B. Richardson and J. G. Triller

In the issue of THE ELECTRICAL ENGINEER of July 4th, under the above heading, Mr. Armstrong, in the abstract of a paper read before the Chicago Electrical Association, makes many statements that tend strongly to mislead one, and the conclusions drawn and the suggestions put forth are of such a nature as to call forth the following, which puts series arc lighting and lighting by alternating arcs in their true relation to one another. As a basis, we will assume that the two systems are equally well constructed, and that the most modern apparatus is used in both cases; in fact, each plant constructed according to modern ideas. Mr. Armstrong has evidently not considered the two systems as being equally well constructed, or has lost sight of this important item in his paper. To avoid argument, we will agree that, under certain conditions, there might be a saving in cost of conductors in favor of the alternating system, but such conditions would naturally be special cases, and it is not *special* but *practical* systems of distribution which should be considered. Cases can be readily cited where the cost of alternating systems of distribution will be at least 10 per cent. greater than that of the series; in fact, in ordinary cases, it would exceed the latter.

The writer of the article is evidently in error as to the statement that the cost of an alternating lamp with transformer does not exceed the cost of a first-class series lamp. The highest grade series lamps can be bought for from \$20 to \$25 apiece. The same can be said of alternating lamps. The lamp which would meet the conditions as specified in the article, namely, that of a focusing lamp with reflector over it, is the highest priced alternating lamp on the market, and the company manufacturing this lamp owns a broad patent covering the use of this reflector, absolutely barring out other companies from using it. The net price of a high grade transformer, having an output sufficient for one lamp at 30 volts, is about \$20, which would make the cost of an alternating lamp with trans-

former from \$40 to \$45 per lamp, against from \$20 to \$25 for a series lamp. The cost per lamp of dynamo capacity is, however, in favor of the alternating, the series costing about \$5.00 per lamp more. Another point which Mr. Armstrong has overlooked, is that there is no double carbon all-night alternating arc lamp upon the market. This would necessitate the re-trimming of lamps for an all-night run, which is a very important item in central station operation. We do not think Mr. Armstrong will find that the enclosed globe he speaks of, is a decided success or can be applied to all lamps.

In the next article, Mr. Armstrong speaks of the advantages gained by running arc lamps in multiple, in that every lamp is independent of the rest. With a modern high grade series lamp, the same can be said, as all lamps are equipped with an automatic cut-out, so that in case the lamp fails to feed properly, it automatically cuts itself out, without interfering with the other lamps on the circuit. It can be readily seen that the alternating arc possesses no advantage over the series arc lamp in the above respect. Further attention is called to the fact that the most an alternating lamp could do would be to blow the fuse. In case of the series lamp there is no necessity for providing such a device, thereby doing away with the extra labor necessary to replace the fuses. Mr. Armstrong also neglects the fact that fuses do not always perform the service for which they were intended, and furthermore, that careless line-men will oftentimes replace the fuse by a piece of copper wire. This is known to have been done in many cases. Where such a thing does occur, it virtually means the destruction of the lamp and transformer.

Referring to the further advantage claimed in favor of the alternating lamp, from the fact that a break in the line will not affect the entire system, we would ask what result would follow from the breaking of the primary line, but we hardly expect in a line that is properly constructed for either system of lighting, that the question of breakage should be considered at all. In reference to the joints interposing any resistance in the whole system, it is thought (as we are considering a well constructed plant,) that an item of this nature is not deserving of any attention whatever. It is stated that the voltage used in connection with the alternating arc lamp is harmless, and that they can be trimmed with safety at any time. Mr. Armstrong has evidently lost sight of the fact that there are perfectly successful automatic cut-outs, or what are known as "separable hangers" used in connection with the series arc work, where the lamp can be entirely disconnected from the line and still maintain the continuity of the circuit. By the use of the above device, series lamps can be trimmed with absolutely no danger. Referring to the next paragraph which deals with the illuminating power of a lamp, a suggestion is made as to the use of a reflector with the alternating lamp. As stated before, this reflector can only be used successfully with a focusing lamp, and one company owns and controls exclusively a patent covering the use of the reflector in this way. As to the case of street lighting, where it is stated that a portion of the rays will be reflected from the under-surface of the foliage, we would hardly expect to find in all cases, trees growing conveniently near the lamp, especially in large cities, or the trees covered with foliage during the winter, when light is needed the most. It might be well to state in reference to tower lighting by direct-current arc, that this method of lighting was one of the very first adopted upon the introduction of series arc lighting, and has been practically abandoned.

In comparing the energy of the two systems, it is stated that the efficiency of good series generators is from 80 to 85 per cent., but after a few years, it falls to 70 per cent. and even as low as 50 per cent. We are not aware of the type of machine that this refers to, but would state that modern series arc machines are sold under a guarantee of 90 per cent. efficiency, and as to deterioration, if the station

be properly handled, we do not see any reason for a lowering of the efficiency. In regard to the statement that reports from 300 arc light stations show that the armature repairs alone, averaged \$3.00 per year per lamp, we can only say that we feel sorry for the persons holding stock in such poorly equipped and operated stations. We have on record a case where 25,500,000 lamp hours were run without losing an armature, 20 machines being used for this service. Our experience has not led us to believe that it is a commonly known fact that arc armatures are more likely to be damaged than alternating armatures, and we cannot agree with the writer in his belief. In the matter of carbons, it is a most important item to procure cored carbons, suitable to be operated with a low voltage alternating current, without having to pay from two to four times what perfectly satisfactory series lamp carbons can be bought for; and while the manufacturers are certainly considering the matter, there is not a carbon manufactured in this country which will give the best results, or results equal to those obtained from using imported carbons. As to the large type of generators, we would further call attention to the fact that to-day generators for series arc lamps of 200 light capacity are on the market, and further, that arc machines are being built to-day for direct connection, their efficiency being very high.

We think that if Mr. Armstrong will look into the cost of step-down transformers of sufficient capacity to operate his ideal station, he will find that the cost of wire is a very small item compared with the cost of his system of distribution; and the cost of running his feeders from his station some three or four miles out in the country will also be quite an item, so that by the time he has this station built, he will find that it will net about three times that of an equally good station located at some more central point. The cost of conduits is an item of no small moment, and this, together with the expense incident to laying them, besides having to provide lead-covered conductors for such an installation, would practically prohibit the "ideal" plant when cheaper and better service can be had from one more conveniently located nearer to the city.

In connection with the transmission of a large current at a potential of 4,000 volts alternating, in the article under discussion, the fact of self-induction and capacity of the line has been entirely lost sight of. In the first place, Mr. Armstrong would be unable to find any manufacturer willing to guarantee his cable for such service with the conditions as laid down. It might, however, be mentioned that high potential distribution is practicable, such, for instance, as at the Deptford station, in London, where a potential of 10,000 volts is successfully used, but this system cost in the neighborhood of \$5,000,000. The impressed E. M. F. must be greatly in excess of the effective E. M. F. at the load, on account of the counter E. M. F. due to inductive effect, to which must be added the ohmic resistance of the line (this latter item is probably the only one which has been considered in the calculations referred to in the article). These are considerations which engineers cannot neglect when planning such a system of distribution. Again, the capacity of the cable may be such as to disrupt the sheathing, thereby grounding one side of the system. Provided the other leg is perfectly insulated, no bad effects would result, but the danger would be greatly increased in the manipulation, and should be guarded against. The inductive effect of the line and of each and every converter as well as that of the lamp itself, will make it necessary to increase the capacity of the generating plant to an extent that would exceed the cost of the series arc plant of equal capacity as regards the number of lamps.

We do not intend that this shall be a negative article, or one which shall be construed as against the use of alternating systems for arc lighting, as we are perfectly well aware that in many cases, the advantages are largely on the side of the alternating system, but the chief advantage, which is not dwelt upon at all, and one which will show itself

most prominently, and be appreciated by the stockholders, (especially in small towns or cities,) is due to the fact that wherever the alternating line goes, we have a system that is more or less flexible, inasmuch as it is possible to supply either incandescent or arc lamps, or both. It is quite common to find in a moderate sized town, a plant with both arc and incandescent machines, the arc lines being generously run not only to the centre of the town, but to the out-skirts, the incandescent lines being run over to the business centre or where a large supply of lights is needed. A person on the outskirts is thus unable to get incandescent light, although the arc line may run in front of his house, and it will not pay the station to run the necessary wires to supply him with a few lights; whereas, if they had originally placed an alternating system instead of series arc machines, as above shown, the entire town would be wired for either arc or incandescent, as the requirements demanded. It is a well-known fact that after a station's receipts equal its expenditures, the addition of light up to the capacity of the machine, especially in the case of incandescent, does not materially increase the cost of operation, and that the revenue obtained from these extra lights can be considered almost entirely profit. In the case of an alternating system, where the arc lamps for street purposes are used, the picking up of 200 incandescent lights on the outskirts would increase the profits probably \$150 per month, and, as this would be equivalent to 10 per cent. on an \$18,000 investment (but in the case cited practically no investment being required), a practical station man and the stockholders would thoroughly appreciate it. If the points brought out by Mr. Armstrong are those which deserve more attention than others, we think his article would tend to prove that alternating apparatus for arc light is a failure compared with the series lighting.

We will further call to mind the fact that, with the system proposed, a transformer would necessarily be required for each arc lamp. Now, after planning such a system, the amount of wire necessary for an additional lamp would incur the running of wires of greater circular-millage and the installing of a transformer of larger capacity. The inflexibility of purely arc lighting by alternating current is, therefore, obvious, and the "ideal" plant of Mr. Armstrong is absolutely impracticable.

LEGAL NOTES.

VALUE OF SERVICES AND STOCK.—ALTENBURG & KLEIBOLTE vs. CITIZENS E. L. & P. CO., OF LOUISVILLE.

Some time since the majority of the stockholders of the Citizen's Electric Light and Power Company, of this city, made a contract with Altenburg & Kleibolte, brokers of Cincinnati, by which the Louisville parties bound themselves to reorganize their company and to accept securities in the new concern, in lieu of those held by them in the old corporation. The Cincinnati brokers, by the terms of the contract agreed to sell \$100,000 of the first mortgage bonds of the reorganized company, if practicable, within sixty days, and if they should succeed they were to receive as compensation \$235,000 of the common stock of the new company. About a week after the contract was made and before the brokers had sold any of the bonds, some of the Louisville stockholders of the Citizens' Electric Light and Power Company, notified Altenburg & Kleibolte that the contract was illegal and that it would not be carried out by the company. Altenburg & Kleibolte then brought suit in the United States Circuit Court for breach of contract, claiming damages in the sum of \$200,000.

The Court, Judge Barr, ruling on a demurrer to the answer of the plaintiffs, holds that, under the new constitution, it was illegal to issue stock except for a fair equivalent in money, property or labor, and, inasmuch as it appeared from the answer that the services to be performed by the plaintiff were not a fair equivalent for the amount of stock to be issued by them, their demurrer was overruled.

THE WORK OF HERTZ.—IV.

BY PROF. OLIVER J. LODGE, F.R.S.

(Concluded.)

Holtz Spark not Exciting Tube; Except by Help of a Polished Knob.

THE powerful disturbance caused by the violent flashes of a Wimshurst or Voss machine it is blind to. If the knobs of the machine are well polished it will respond to some high harmonics, due to the vibrations in the terminal rods, and these are the vibrations to which it responds when excited by a coil. The coil should have knobs instead of points. Sparks from points or dirty knobs hardly excite the coherer at all. But hold a well-polished sphere or third knob between even the dirty knobs of a Voss machine, and the coherer responds at once to the surgings got up in it.

Feeble short sparks again are often more powerful exciters than are strong long ones. I suppose because they are more sudden.

This is instructively shown with an electrophorus lid. Spark it to a knuckle, and it does very little. Spark it to a knob and it works well. But now spark it to an insulated sphere, there is some effect. Discharge the sphere, and take a second spark, without recharging the lid. Do this several times, and at last, when the spark is inaudible, invisible, and otherwise imperceptible, the coherer some yards away responds more violently than ever, and the spot of light rushes from the scale.

If a coherer be attached by a side wire to the gas pipes and an electrophorus spark be given to either the gas-pipes or the water pipes or even to the hot water system in another room of the building, the coherer responds.

In fact, when thus connected to gas-pipes one day when I tried it, the spot of light could hardly keep five seconds still. Whether there was a distant thunderstorm, or whether it was only picking up telegraphic jerks, I do not know. The jerk of turning on or off an extra Swan lamp can affect it when sensitive. I hope to try for long-wave radiation from the sun, filtering out the ordinary well-known waves by a black-board or other sufficiently opaque substance.

We can easily see the detector respond to a distant source of radiation now, viz., to a 6 in. sphere placed in the library between coil knobs.

Also I exhibit a small complete detector made by my assistant, Mr. Davies, which is quite portable and easily set up. The essentials are all in a copper cylinder three inches by two. A bit of wire a few inches long, pegged into it, helps it to collect waves. It is just conceivable that at some distant date, say by dint of inserting gold wires or powder in the retina, we may be enabled to see waves which at present we are blind to.

Observe how simple the production and detection of Hertz waves are now. An electrophorus or a frictional machine serves to excite them, a voltaic cell, a rough galvanometer, and a bad contact serves to detect them. Indeed, they might have been observed at the beginning of the century, before galvanometers were known. A frog's leg or an iodide of starch paper would do almost as well.

A bad contact was at one time regarded as a simple nuisance because of the singularly uncertain and capricious character of the current transmitted by it. Hughes observed its sensitiveness to sound waves, and it became the microphone. Now it turns out to be sensitive to electric waves if it be made of any oxidizable metal (not of carbon), and we have an instrument which might be called a micro-something, but which, as it appears to act by cohesion, I call at present a coherer. Perhaps some of the capriciousness of an anathematized bad contact was sometimes due to the fact that it was responding to stray electric radiation.

The breaking down of cohesion by mechanical tremor is an ancient process, observed on a large scale by engineers in railway axles and girders; indeed, the cutting of small girders by persistent blows of hammer and chisel reminded me the other day of the tapping back of our cohering surfaces after they have been exposed to the welding effect of the electric jerk.

If a coherer is shut up in a complete metal enclosure, waves cannot get at it, but if wires are led from it to an outside ordinary galvanometer, it remains nearly as sensitive as it was before (nearly, not quite), for the circuit picks up the waves and they run along the insulated wires into the closed box. To screen it effectively, it is necessary to enclose battery and galvanometer and every bit of wire connection; the only thing that may be left outside is the needle of the galvanometer. Accordingly, here we have a compact arrangement of battery and coil and coherer, all shut up in a copper box. The coil is fixed against the side of the box at such height that it can act conveniently on an outside suspended compass needle. The slow action of the coil has no difficulty in getting through copper, as everyone knows; only a perfect conductor could screen off that, but the Hertz waves are effectively kept out by sheet copper.

It must be said, however, that the box must be exceedingly well closed for the screening to be perfect. The very narrowest chink

permits their entrance, and at one time I thought I should have to solder a lid on before they could be kept entirely out. Clamping a copper lid on to a flange in six places was not enough. But by the use of pads of tinfoil, chinks can be avoided, and the inside of the box becomes then electrically dark.

If even an inch of the circuit protrudes, it at once becomes slightly sensitive again; and if a single branch wire protrudes through the box, provided it is insulated where it passes through, the waves will utilize it as a speaking tube, and run blithely in. And this whether the wire be connected to anything inside or not, though it acts more strongly when connected.

If wires are to be taken out of the box to a coherer in some other enclosure, they must be enclosed in a metal tube, and this tube must be well connected with the metal of both enclosures, if nothing is to get in but what is wanted.

Similarly, when definite radiation is desired, it is well to put the radiator in a copper hat, open in only one direction. And in order to guard against reflected and collateral surgings running along the wires which pass outside to the coil and battery, as they are liable to do, I am accustomed to put all these things in a packing case lined with tinfoil, to the outside of which the sending hat is fixed, and to pull the key of the primary exciting circuit by a string from outside.

With reference to the reflecting power of different substances it may be interesting to give the following numbers, showing the motion of the spot of light when 8 in. waves were reflected into the copper hat, the angle of incidence being about 45 deg., by the following mirrors:—

Sheet of window glass.....	0 or at most 1 division.
Human body.....	7 divisions.
Drawing board.....	12 "
Towel soaked with tap-water..	12 "
Tea-paper (lead ?).....	40 "
Dutch metal paper.....	70 "
Tinfoil.....	80 "
Sheet copper.....	100 and up against stops.

Even then, with the lid of the hat well clamped on, something gets out, but it is not enough to cause serious disturbance of qualitative results. The sender must evidently be thought of as emitting

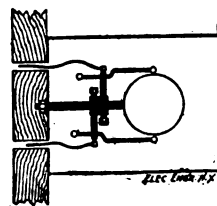


FIG. 20.

Spherical Radiator for emitting a Horizontal Beam, arranged inside a Copper Hat, fixed against the inside of a Wooden Box. One-eighth natural size. The wires pass out through glass tubes not shown.

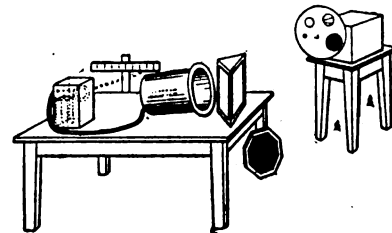


FIG. 21.

General arrangement of experiments with the Copper "Hat," showing the Wooden Box on a Stool, inside which the Radiators were fixed; the Copper Hat containing the Coherer; the Metal Box containing Battery and Galvanometer Coil; a Paraffin Prism; and a Polarizing Grid.

a momentary blaze of light which escapes through every chink. Or, indeed, since the waves are some inches long, the difficulty of keeping them out of an enclosure may be likened to the difficulty of excluding sound; though the difficulty is not quite so great as that, since a reasonable thickness of metal is really opaque. I fancied once or twice I detected a trace of transparency in such metal sheets as ordinary tinplate, but unnoticed chinks elsewhere may have deceived me. It is a thing easy to make sure of as soon as I have more time.

One thing in this connection is noticeable, and that is how little radiation gets either in or out of a small round hole. A narrow long chink in the receiver box lets in a lot; a round hole the size of a shilling lets in hardly any, unless, indeed, a bit of insulated wire protrudes through it like a collecting ear trumpet.

It may be asked how the waves get out of the metal tube of an electric gas-lighter. But they do not; they get out through the handle, which being of ebonite is transparent. Wrap up the handle tightly in tinfoil, and a gas-lighter is powerless.

Optical Experiments.

And now in conclusion I will show some of the ordinary optical experiments with Hertz waves, using as source either one of two devices; either a 6 in. sphere with sparks to ends of a diameter (Fig. 20), an arrangement which emits 9 in. waves, but of so dead-beat a character that it is wise to enclose it in a copper hat to prolong them, and send them out in the desired direction; or else a 2 in. hollow cylinder with spark knobs at ends of an internal

diameter. This last emits 8 in. waves of a very fairly persistent character, but with nothing like the intensity of one of the outside radiators.

As receiver there is no need to use anything sensitive, so I employ a glass tube full of coarse iron filings, put at the back of a copper hat with its mouth turned well askew to the source, which is put outside the door at a distance of some yards, so that only a little direct radiation can reach the tube. Sometimes the tube is put lengthways in the hat instead of crossways, which makes it less sensitive, and has also the advantage of doing away with the polarizing or rather analyzing power of a crossway tube.

The radiation from the sphere is still too strong, but it can be stopped down by a diaphragm plate with holes in it of varying size clamped on the sending hat.

Having thus reduced the excursion of the spot of light to a foot or so, a metal plate is held as reflector, and at once the spot travels a couple of yards. A wet cloth reflects something, but a thin glass plate, if dry, reflects next to nothing, being, as is well known, too thin to give anything but "the black spot." I have fancied that it reflects something of the 8 inch waves.

Refracting Prism and Lens.

A block of paraffin about a cubic foot in volume is cast into the shape of a prism with angles 75 deg., 60 deg., and 45 deg. Using the large angle, the rays are refracted into the receiving hat (Fig. 21), and produce an effect much larger than when the prism is removed.

An ordinary 9 in. glass lens is next placed near the source, and by means of the light of a taper it is focussed between source and receiver. The lens is seen to increase the effect.

Arago Disc; Grating and Zone-plate.

The lens helps us to set correctly an 18 in. circular copper disc in position for showing the bright diffraction spot. Removing the disc the effect is much the same as when it was present. Add the lens and the effect is greater. With a diffraction grating of copper strips 2 in. broad and 2 in. apart, I have not yet succeeded in getting good results. It is difficult to get sharp nodes and interference effects with these sensitive detectors in a room. I expect to do better when I can try out of doors away from so many reflecting surfaces; indoors it is like trying delicate optical experiments in a small whitewashed chamber well supplied with looking-glasses; nor have I ever succeeded in getting clear concentration with this zone-plate having Newton rings fixed to it in tinfoil. But really there is nothing of much interest now in diffraction effects except the demonstration of the waves and the measure of their length. There was immense interest in Hertz's time, because then the wave character of the radiation had to be proved, but every possible kind of wave must give interference and diffraction effects, and their theory is, so to say, worked out. More interest attaches to polarization, double refraction, and dispersion experiments.

Polarizing and Analyzing Grids.

Polarization experiments are easy enough. Radiation from a sphere is already strongly polarized, and the tube acts as a partial analyser, responding much more vigorously when its length is parallel to the line of sparks than when they are crossed; but a convenient extra polarizer is a grid of wires something like what was used by Hertz, only on a much smaller scale; say an 18 in. octagonal frame of copper strip with a harp of parallel copper wires (see Fig. 21). The spark-line of the radiator being set at 45 deg., a vertical grid placed over receiver reduces the deflection to about one-half, and a crossed grid over the source reduces it to nearly nothing.

Rotating either grid a little rapidly increases the effect, which becomes a maximum when they are parallel. The interposition of a third grid, with its wires at 45 deg. between two crossed grids, restores some of the obliterated effect.

Radiation reflected from a grid is strongly polarized in a plane normal, of course, to that of the radiation which gets through it. They are thus analogous in their effect to Nicols, or to a pile of plates.

The electric vibrations which get through these grids are at right angles to the wires. Vibrations parallel to the wires are reflected or absorbed.

Reflecting Paraffin Surface.

To demonstrate that the so-called plane of polarization of the radiation transmitted by a grid is at right angles to the electric vibration,¹ i. e., that when light is reflected from the boundary of a transparent substance at the polarizing angle the electric vibrations of the reflected beam are perpendicular to the plane of reflection, I use the same paraffin prism as before; but this time I use its largest face as a reflector, and set it at something near the polarizing angle. When the line of wires is parallel to the plane of incidence, in which case the electric vibrations are perpendicular

to the plane of incidence, plenty of radiation is reflected by the paraffin face. Turning the grid so that the electric vibrations are in the plane of incidence, we find that the paraffin surface set at the proper angle is able to reflect hardly anything. In other words, the vibrations contemplated by Fresnel are the electric vibrations; those dealt with by McCullagh are the magnetic ones.

Thus are some of the surmises of genius verified and made obvious to the wayfaring man.

ELECTRICITY AS A FIRE HAZARD.—IV.

BY W. J. JENKS.

ORIGIN OF ELECTRICAL INSURANCE RULES.

It is interesting and instructive now that the possible sources of danger to property from the presence of electric light and power circuits are well understood and rules have been formulated and can be enforced which practically counteract these dangers, to glance at the indefinite and somewhat contradictory views held by those most intelligent in applied electricity less than twelve years ago, by quoting from publications of that time some extracts showing the fears entertained by the electric lighting companies themselves, and also by the fire insurance fraternity, of accidents and damage by the escape from proper control of currents representing mechanical forces, either for usefulness or for mischief, vastly in excess of any which had been employed in the prior applications of electricity.

The underlying principles of the distribution of electrical energy to electric lamps, whether arc or incandescent, were the same that had for many years been utilized in its distribution for the purposes of telegraphy, gas lighting devices and the like, because these prior forms of translators had been operated both in series and in multiple arc; but, as I have before indicated, the very small expenditure of electrical potential in each unit of the resistance of a gas lighting circuit made the energy which could possibly be concentrated at any one point so insignificant in its capability of doing mischief that when the electric lighting systems proposed to expend many volts in each ohm of the resistance of the circuit—or, in other words, to employ many amperes—the mechanical horse-power represented by such lighting currents demanded the most extraordinary care in the matter of keeping the electrical energy on the wires—or, in other words, in the matter of keeping the circuit effectually insulated from everything which would tend to divert forces of dangerous magnitude from their proper paths. It is not surprising that the first electric light constructors and insurance experts should have failed to appreciate the dangers to life and property which were afterward found to result from an ignorant or careless method of insulating circuits proceeding from dynamos operated by powerful steam engines and similar sources of energy.

The following letter from a representative of the insurance interests who has always stood in the front rank of progress in all that pertains to practical security from fire, illustrates the state of knowledge prior to 1880:

BOSTON M.F.A.S. MUTUAL FIRE INS. CO.
BOSTON, MASS., NOV. 21, 1879.

G. W. STOCKLY, Esq., V. P., Telegraph Supply Co.

Dear Sir:—You are at liberty to say that this company prefers the electric light (so guarded that points of incandescent carbon cannot fall from it) to any other known mode of lighting, having as yet been unable to find any cause of danger in its use, except as above stated.

Yours very truly,

EDWARD ATKINSON, President.

At the time the above was written the arc lamp was the only practical device for electric lighting.

There were, even as late as 1881, very few men engaged in electrical work who had any well defined idea of the distinctions which should be drawn as between the insulation of multiple arc circuits, and of series circuits employing very much higher pressure. In the multiple arc circuit, while the total pressure of the system was, and is, usually restricted to a comparatively low standard, the amperes of current are limited only by the number of lights connected with a given system; and, as the heating effects produced in a given circuit increase directly as the square of the amperes, any material rise of current strength was found to cause a very dangerous condition of things. It was to obviate this danger that the attention of the insurance people was at first directed to the regulation of the covering or insulation by which electric light wires were to be protected, so that an abnormal heating of the wire might not result in setting on fire the insulating covering, and thus the combustible material by which this insulation might be surrounded or supported. It was also discovered that leakages to earth, which had always occurred to a greater or less extent in the history of all prior systems of electrical distribution, resulted in something very much more serious than a mere temporary interference with the working of the system and the convenience of the user, because such leakage might, when backed by the powerful dynamo and steam engine, develop such great heat energy as to frequently set fires.

These new conditions in the operation of electrical apparatus

1. Cf. Trouton, in *Nature*, Vol. XXXIX., p. 398; and many optical experiments by Mr. Trouton, Vol. XL., p. 384.

and the apprehension which they excited in the minds of the fire insurance fraternity, are clearly set forth in a paper read at the first annual meeting of the United Fire Underwriters in America, by William A. Anderson, of New York, Nov. 16, 1881, entitled "The Dangers of Electric Lighting." In presenting this paper Mr. Anderson represented the New York Board of Fire Underwriters, and also (as its chairman) a committee of that board called the "Committee on Police and Origin of Fires." The following are brief extracts from this paper, which was printed in pamphlet form at that time, and of which copies are still preserved in the office of the New York Board:

"Electric lights are now so rapidly being introduced into our larger stores, hotels, mills and manufacturing establishments, that it becomes the duty of underwriters to carefully examine into the question, and if danger exists, to take prompt and decided measures to guard against the same at every point.

"The New York Board of Fire Underwriters, some months ago, delegated to their Committee on Police and Origin of Fires, this duty, and in their investigations (which have occupied considerable time and attention, and which are now only partly performed) they discovered the evidence of existing and threatened danger of a serious character.

"To guard against the same, the said board, upon the recommendation of this committee, adopted a preliminary standard of requirement for 'electric lights, wires, lamps, etc.' which will be amended and added to from time to time, as they learn more of the subject, and as necessity may demand.

"First. Wires to have fifty per cent. excess of conductivity above the amount calculated as necessary for the number of lights to be supplied by the wire.

"It is currently reported that the several fires that occurred at the Paris Exhibition were mainly caused by thin wires and contact of wires.

"If a wire has not conductivity sufficient to carry the current of electricity the wire will become heated, and, if insulated, will burn the insulation, and, if not insulated, will burn whatever combustible substance it comes in contact with, and also consume the wire.

"Second. Wires to be thoroughly insulated and doubly coated with some approved material.

"The New York committee were strongly in favor of recommending that non-inflammable covering only should be used; but it was represented to them, and it has since been proved by test, that some of the insulating compounds, in themselves inflammable, are better insulators for electrical purposes, and until this particular point is better understood they recommend the use of such doubly covered insulators as shall be approved; and it is the intention of the committee to test, as far as possible, a sample of each wire submitted, by applying to it a current of electricity greater than the amount calculated to be used, and also to ascertain by test whether it will stand contact with conducting substance without burning.

"The New York committee through their inspector, found many of the wires—and, in fact, it may be said most of the wires—that were placed in buildings previous to the Underwriters' action in the matter, were without proper insulation and some without any covering whatever; and if any underwriter has the least doubt as to the danger of such equipment, we would ask him to cross-circuit such wires with one of a smaller size and watch the results.

"Some covered wires are now in use that appear to be safe; but we firmly believe that if electric lights are to be permanent with us, that the wire of the future must be different from any now in use, for, in our opinion, full protection to life and property require that the conductors of so strong an agent should not only be covered with a substantial insulator, but in addition be firmly encased in a leaden pipe, or in some such manner protected from wear and friction.

"Third. All wires to be securely fastened by some approved non-conducting fastening and to be placed at least two and one-half inches for incandescent lights, and eight inches for arc lights, from each other, and eight inches from all other wires and from all metal or other conducting substance, and to be placed in a manner to be thoroughly and easily inspected by surveyors.

"The conducting framework of the chandeliers and lamp must be insulated and covered the same as wires.

"One illuminating company are now engaged in laying their street system, which consists of two copper wires or rods insulated from each other and from the heavy iron pipe in which they are enclosed—the whole buried about two feet in the ground.

"Insulated wires will connect with the house main at each floor; and at each junction from the street main, service main, house main, and, in fact, at each connection up to the lamp socket, at the base of the chandelier, the company propose to have an automatic fusible 'cut-off,' called a safety catch, which they claim to be a complete cut-off in case of crossing of wires, accident to lamps, or any contact with conducting substance that may cause any increase of resistance or unduly heat the wires. (1)

"In some few cases, circuits have been found grounded by the conducting wire being fastened to a gas or water pipe.

"This should never be allowed, for it largely increases the chances of the electric current being carried to the telephone wires, and by the latter to telephone instruments causing fire in them. And another danger to be apprehended in grounding of wires is the fact that a bad joint in a gas pipe may be of such poor conductivity that the passage of a current of electricity in large volume would be likely to heat the pipe red hot, and ignite escaping gas."

The general feeling of apprehension which was excited by a better knowledge of the subject on the part of the fire insurance company is further illustrated by a series of reports made early in 1882 by Mr. Edward Atkinson, as President of the Boston Manufacturers' Mutual Fire Insurance Company. The first of these was entitled "Electric Lighting No. 1," and was dated "Boston, January 16, 1882." Two or three paragraphs will indicate its tone:

"We are engaged in making all thorough investigation as to the alleged dangers which may occur from the electric light and other matters connected therewith.

"The greatest care should, therefore, be taken in choosing the position of the wires; and they should never be carried along the under side of the beams and transverse thereto, or in any proximity to belts, shafting or pipes.

"The danger of suspended wires exposed to the action of machinery will be apparent. We are not yet fully prepared to suggest the true method of placing wires and protecting them; but, having indicated the danger, we ask suggestions from those who have used the electric light, in order to enable us to work out the proper instructions.

"It may be added that we have not yet found any cause or danger of fire from the use of the electric method of lighting which may not be avoided if the right method and proper care be used in putting up and operating the apparatus; but electricity is a force which cannot be too carefully controlled, directed and watched, if generated in currents of considerable intensity."

The third of these reports of Mr. Atkinson was entitled "Electric Lighting No. 3," and was dated "Boston, March 6, 1882." Among other significant utterances were the following:

"In view of the apparent novelty in the application of electricity now made or contemplated and the indefinite sense of danger which pervades the community regarding its use, it may be as well for us to assume that most of our members are now, or were lately, in the same condition of mind as ourselves; to wit, suddenly called upon to investigate a subject of which they knew little, described in technical language of which they knew nothing.

"We use the expression 'apparent novelty' for this reason—the application of this source or energy, named electricity, to the production of light or to the transmission of power, is in fact no novelty whatever; all that has happened in these later days has been what many persons, who have not examined the subject, are still supposing to be in the somewhat distant future, to wit, bringing this force into the domain of applied science so economically as to be commercially useful.

"Each machine should be used with complete wire circuits, and connection of wires with pipes, or the use of ground circuits in any other method is absolutely prohibited."

STEAM AND ELECTRICITY AT THE POORMAN MINE.

Mr. Clark, general manager of the Cœur d'Alene Silver & Lead Mining Co. in Idaho, writes: "In respect to the relative merits of steam and electricity at the Poorman Mine, I will say that the amount saved in fuel is about \$100 a day. This, of course, is due to the fact, that we generate electricity by water power. How electricity would compare with steam in the matter cost, if the former were generated by steam power, I am not prepared to say, but am of the opinion that where steam has to be transmitted a long distance underground, particularly where it is wet, that electricity generated with steam and transmitted to the pumps or other machinery will be found to be the most economical, the percentage of loss in transmission being so much less; in addition to this, the cumbersome steampipes, with their destructive effect on shaft timber, are avoided. We have five machines in use; two 17 k. w. at the generating station one and one-half mile distant from our works where they are operated with Pelton wheels under 800 feet head; one 175 k. w. to drive our concentrator; one 150 k. w. machine for the pump, raising 500 gallons of water per minute 500 feet; and one 175 k. w. for the compressor. This system has been almost two years in operation."

THE VAN CHOATE CO. will, it is stated, have a factory at Foxboro, Mass., making 10,000 lamps a day and good for a productive capacity of \$3,000,000 per year. The factory is to turn out lamps, dynamos, motors and cars.

ELECTRICAL TRANSMISSION OF POWER WITH TWO-PHASE CURRENTS FOR MINING PURPOSES IN FRANCE.¹

ONE of the most interesting plants for the electrical transmission of power for coal mining purposes in Europe has been completed and set in operation at the Decize Collieries in the Nièvre Department of France, which are owned by MM. Schneider & Co. This installation is remarkable from the fact that two-phase alternating currents are employed for the transmission, and two-phase alternating current Tesla motors are used for reconverting the electrical energy into mechanical power at the different pits. In designing this plant the problem to be solved was to erect a central generating station for the distribution of electrical energy at the different pits, where it could be utilized in electromotors for operating ventilating fans, hauling machinery, pumps and for lighting purposes. A general idea of what had to be accomplished is shown in the annexed table:—

SITE.	DISTANCE FROM GENERATING STATION.	ELECTRICAL MACHINERY OR LAMPS RECEIVING THE CURRENT TRANSMITTED.
1.— <i>West.</i>	YARDS.	
Puits des Chagnats	5,090	30 H. P. electric motor *
Pendue des Lacets.....	3,466	" " " "
Puits des Coupes.....	2,058	" " " "
Puits des Zagots.....	1,084	Electric hauling machine of 15 H. P. †
2.— <i>Generating Station.</i>		
Various installations.....	....	Six arc and 100 incandescent lamps. ‡
3.— <i>East.</i>		
Pendue des Marizy.....	1,300	30 H. P. electric motor & 24 arc lamps. §
Sort'g & wash'g shops of the Pré-Charpin.....	2,490	570 incandescent lamps of 16 c. p. ‡
Champvert.....	3,250	12 H. P. power electric motor. |

* Used for ventilating fan. † Inclined plane. ‡ Lighting. § Ventilating fan and lighting. | Pumping.

The generating station is situated respectively at distances of from 3.1 miles and 1.86 miles from the extreme points which have to be supplied with current. It contains a battery of six boilers and two units (steam engines and dynamos), each of a capacity of 100 kilowatts; a further unit will shortly be laid down. The two units may be worked singly or in parallel. The engines are of the horizontal non-condensing type, running at 200 revolutions per minute, and driving the diphas alternators by means of belting. A notable feature in this connection is the fact that each electrical unit comprises a twin alternator, or in reality two machines, placed one at each end of the shaft, the driving pulley carrying the engine belt being arranged in the middle of the shaft. The generators are Ziperowsky ten-pole alternators, with revolving field magnets. The ten field magnets are connected together in series, and the exciting current is led to them by means of two metallic rings carried on an extension of the driving shaft on the opposite side to that of the driving pulley—that is to say, on an outer extension of the shaft. Two ordinary brass brushes press upon these rings, to which the exciting current is furnished by a direct-current dynamo. This latter machine is operated by a belt from the shaft of the alternator. At 900 revolutions a minute this direct-current dynamo supplies the exciting current for the twin alternator, being between 25 and 30 amperes at 110 volts. The fixed armature of the alternators is formed of ten coils, any one of which can be withdrawn and replaced with little trouble.

The current is transmitted mainly by means of overhead wires to the points of the utilization, the only portion laid underground being towards the end of the principal line leading to the Chagnats Pit. The wires forming the overhead line are of silicon-bronze, and are carried on porcelain insulators attached to poles 24 ft. high. The diameter of the wires constituting the principal line to the western part of the district is 6 mm., and 4 mm. in the case of the remainder of the line. It is noteworthy that the same poles carrying the transmission wires also support the telephone wires, the latter being arranged 12 ft. from the ground. In order to counteract the effects of induction in the telephone wires, the line conductors are crossed at distances averaging 540 yards. The small portion of the underground line forms a lead-covered cable, laid in a wooden conduit, as also does the telephone line for the same distance. Suitable lightning conductors are provided at the generating and distributing sub-stations and at intervals along the line. The electromotors at the sub-stations, where the current is utilized for the different purposes mentioned in the table given above, are of the same type as the generators. These diphas motors are easily set in operation, and are to all intents and purposes left to themselves for several hours together. The only attention they receive is the visit of an employé every six or eight hours to ascertain whether the motors are working properly. The sub-stations are situated in the forest, and the faculty of working on this system as compared with the erection in each

place of a boiler, steam engine and ventilating fan is considered to be remarkable, apart from the question of the cost of transporting fuel.

THE PACIFIC CABLE OUTLAY AND EARNINGS.

ONE of the most important questions considered by the recent Intercolonial Conference at Ottawa, Canada, was that of submarine cable communication between the various colonies. Several British colonies took part in the conference, and those of Canada, Australia and New Zealand were ready to support the plan of laying a cable, across the Pacific, whose ends should be landed within British territory. Among those watching and assisting more or less directly in the work of the Conference was Mr. Alexander Siemens, of Siemens Bros. & Co., of London. Both to the delegates and to the press, Mr. Siemens furnished some most valuable data, and subjoined is a précis of his statements on the subject.

The cable could be laid, he observed; the only question was as to what it would cost. His calculation was that a cable of the best description could be laid for an outlay of £2,000,000, and he backed his views by a series of very carefully prepared calculations. All the sums given are absolutely outside figures, he said, and in addition to the weight attaching to them from his own experience he has had them checked off by prominent cable experts; so that the actual expenditure could hardly fall outside of them, and is far more likely to be less. The first calculation which he presented was that of the capital account. The debit side of that was: Capital to be raised under Government guarantee at 3 per cent. £2,000,000.

On the credit side appears:—

7,340 nautical miles cable.....	£1,720,000
Steamers.....	200,000
Buildings, etc.....	30,000
Working capital.....	50,000
	£2,000,000

Further details are given by Mr. Siemens of these estimates. The route upon which he bases his calculations consists of four sections, Ahaipara Bay (N. Z.) to Suva (Fiji Islands); Suva to Canton, or Mary (Phoenix Islands); Canton to Necker Island, and Necker Island to Vancouver, B. C., the total length being, as already stated, 7,340 nautical miles. The item next after that of the actual cost of the cable is that of £200,000 for steamers. Two of these, of about 1,800 tons each, would be needed, to cost £100,000 each. The items of £30,000 for buildings and instruments is made up as follows:

3 cable houses, £300.....	£ 900
3 sets fittings for do., £200.....	600
12 large houses at £1,000.....	12,000
12 outfits for same at £500.....	6,000
14 sets recorders complete at £400.....	5,600
5 sets testing instruments, with extra spares at £240.....	1,200
Transport and erection.....	3,700
Total.....	£30,000

This then will be the initial cost of the cable. It will be seen that £50,000 is left for the working expenses, and the question arises as to what these expenses will be. The yearly working expenses Mr. Siemens divides as follows:—

(a) General management.....	£ 5,000
(b) Staff and officers expenses at stations.....	24,000
(c) Repair and maintenance of cables.....	90,000
Total annual outlay.....	£119,000

The first item in this explains itself. Details for the second were given by Mr. Siemens as follows:

Vancouver, B. C.	Per Annum.
1 superintendent.....	£ 400
4 clerks at £200.....	800
2 messengers at £50.....	100
4 boys at £30.....	120
Taxes, ground rent, renewals and repairs.....	200
Stationery, insurance, advertising.....	200
Sundries unforeseen.....	200
	£2,000

Neckar and Canton Islands (each).

1 superintendent.....	£ 600
8 clerks at £500.....	4,000
3 messengers at £100.....	300
Rations, £1 per week per head.....	600
Sundries unforeseen.....	500

2 x £6,000 £12,000

1. Colliery Guardian

Suva (Fiji) and Ahaipara (N. Z.) each.	
1 superintendent.....	£ 500
8 clerks at £400.....	3,200
8 messengers at £80.....	240
Rations £1 per week per head.....	600
Sundries unforeseen.....	480
	2 x £5,000 £10,000

Total annual cost of staff and office expenses...£24,000

The larger salaries given at Necker and Canton Islands are caused by the nature of the places, which are mere rocks, and very undesirable habitations.

The third item, that of repair and maintenance of the cables, is the most difficult to estimate, and the expenditure falls into two parts, the fixed and the variable. The fixed part consists in the maintaining in efficient order of the two repairing steamers, which can be done for £100 per month, per steamer, and in wages, victualing and other expenses, which would be covered by an allowance of £20 per day per steamer. These vessels would have to be kept ever ready to go out to attend to breaks, but would not be likely on an average to be at sea more than two months in the year, while it is not likely that more than 200 miles of cable would be used up in repairs in a year. It is very possible that far less would be needed, for good ocean cables do not deteriorate and are practically good for ever, while at the rate of repair calculated upon, the entire cable would be renewed in 37 years; so that here again a very liberal calculation has been made. This repair rate would be about £12 per nautical mile per year, while it is usual to calculate £6 per nautical mile, to cover repairs, and one Atlantic company keeps 6,000 miles of cable in efficient working order for about £4 per nautical mile. The full calculation of annual repairs and maintenance made by Mr. Siemens is:

(a) Fixed expenses—

Two steamers, repair of hull and machinery, at £1,200 each.....	£2,400
Wages of crew, victualing, etc., 2 x 365 days at £20 per day.....	14,600

(b) Variable expenses—

Average of two months at sea for each steamer, ropes and other stores, extra pay, etc., at £125 per day.....	15,000
100 nautical miles of cable at £200 per nautical mile (for shallower water).....	20,000
100 nautical miles cable at £350 per nautical mile (for deeper water).....	35,000
Sundries.....	8,000

Total.....£90,000

One of the steamers would be stationed at Vancouver, B. C., and the other at Suva, Fiji Islands.

This, then, covers the expense of the work, both the initial outlay and the annual expense and maintenance account. The

tween America and Australasia increases, so will the cable communication; the cable will both promote more traffic and benefit by it. From a calculation made in 1887 by Mr. Henneker Heaton, it appears that the 26 submarine cable companies then in existence had spent on an average £350 pounds for each nautical mile of their cables, and derived an income of £31 15s per nautical mile; with many of the companies the capital outlay was far less and the income far greater. Now, at the very liberal calculations made and already given, the proposed Pacific cable would cost £273 per mile; and if it met with average success and earned, say £30 per mile, the annual income would be £230,000. For the first two or three years this figure cannot be expected to be reached, but it is under the average of the earnings of all submarine companies of 1887, and since then ocean telegraphic communication has rapidly increased. One Atlantic company has in the past three years earned an average of £50 per mile per year.

If the new Pacific cable gets its share and charges two shillings per word, 2,200,000 words per year would be enough to realize this income, and the cable, which would be put in for £2,000,000, could send fifteen words per minute on the recorder, or 7,000,000 words per year; ample provision being made in the estimates for a staff large enough to afford relays sufficient to do this. And by introducing duplex working the speed could be doubled. Granting then an income of £230,000, the revenue account would stand as follows:—

Debit side:—

General management.....	£ 5,000
Staff, etc.....	24,000
Repairs and renewals.....	90,000
To profit and loss account.....	101,000
	£220,000

Credit side:—

Earnings.....	£220,000
---------------	----------

The profit and loss account would stand thus:—

Debit side:

Three per cent. interest on capital.....	£ 60,000
Two per cent. amortization of capital.....	40,000
Carried forward.....	1,000
	£101,000

Credit side:

From revenue account.....	£101,000
---------------------------	----------

On this calculation Mr. Siemens held that the line is feasible, both practically and commercially.

ANOTHER NEW ATLANTIC CABLE.

A special dispatch from St. John's, N. F., of July 8, says: The cable steamer "Britannia," Capt. Kennedy, arrived at Heart's Content, a seaport of Newfoundland, on the southeast side of Trinity Bay, last night from London, having on board about 190

THE ATLANTIC CABLES.

No. of Cables.	Company.	Laid.	Between.	Length in Miles.
5	Anglo-American Telegraph Co.....	1858	{ Ireland and Newfoundland..... }	Abandoned.
		1865		
		1866		
		1873		
		1874	" ".....	1,885
		1880	" ".....	1,846
		1884	" ".....	1,890
1	Direct U. S. Cable Company.....	1874-5	France and St. Pierre Miquelon.....	1,850
			Ireland and Nova Scotia.....	2,685
1	Paris and New York Cable Co.....	1879	France and St. Pierre Miquelon.....	2,565
2	American Cable Company.....	1881	{ Land's End (England) and Nova Scotia.... }	2,242
		1882		
3	Commercial Cable Company.....	1884	{ Ireland and Nova Scotia..... }	2,581
		1884		
		1894		2,576

crucial point comes: Will the cable pay? Mr. Siemens holds that it should. It appears by Sir John Pender's statement that the existing Australian traffic is worth £209,628 net for 1,306,716 words, or 3s 1½d per word. It is only fair to assume that the new line would get half of this traffic, and so realize at once, say £104,000 per annum. Now, in the first year of the new cable the expenses for repairs would likely not be very great, and so the first year's business of the Canadian-Australian line, on this basis of calculation, would pay working expenses and leave an ample margin. But the cable is being laid with an eye to the future as well as the present, Mr. Siemens observed, and as the trade be-

miles of cable, the shore end of the new Anglo-American cable. The "Britannia" will be followed on Tuesday by the "Scotia" with the deep-sea section of the cable. The "Britannia," after receiving a supply of coal, will start to lay the cable, shore and outward. She will be accompanied by the "Scotia," which, when she receives the end of the cable to be spliced from the "Britannia," will begin to pay out her cargo of cable, the "Britannia" meantime proceeding to London to receive the final section, returning in time to meet the "Scotia," when the great job will be completed. The cables across the North Atlantic will now be as shown in the above table.

THE ELECTRICAL ENGINEER.

(Incorporated)

PUBLISHED EVERY WEDNESDAY AT

303 Broadway, New York.

Telephone: 3860 Cortlandt.

Cable Address: LENGINEER.

Gen. M. PERKINS, President.

F. R. COLVIN, Treas. and Business Manager.

Edited by

T. CONMERFORD MARTIN AND JOSEPH WITKLER.

Associate Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SEAW, Room 70—690 Atlantic Avenue, Boston, Mass.

Western Editor and Manager C. KAMMEYER, 1439 Monadnock Building, Chicago, Ill.

New York Representative, 303 Broadway, { W. F. HANES.
Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada	per annum	\$3.00
Four or more Copies, in Clubs (each)		2.50
Great Britain and other Foreign Countries within the Postal Union		5.00
Single Copies		.10

[Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1893.]

EDITORIAL ANNOUNCEMENTS.

Addresses.—Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of THE ELECTRICAL ENGINEER. Communications for the attention of the editors should be addressed, EDITOR OF THE ELECTRICAL ENGINEER, 303 Broadway, New York City.

Communications suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.

VOL. XVIII. NEW YORK, JULY 25, 1904. No. 325.

CONTENTS.

EDITORIAL :—

Submarine Cable Activity	70
Political or Private Monopolies of Public Service	71
Power Transmission in California	71

ARTICLES :—

Gas Engines and Electrical Transmission from the Coal Mines	61
The Cottrell Telephone Transmitter Without Electrodes (Illustr.)	62
Transmitting Pictures by Electricity (Illustr.)	62
Street Lighting by Alternating Arcs	63
The Work of Heriz—IV. (concluded)	65
Electricity as a Fire Hazard—IV.	66
Electrical Transmission of Power with Two-Phase Currents for Mining Purposes in France	68
The Pacific Cable Outlay and Earnings	68
Another Atlantic Cable (with table)	69
The Electric Lighting of Railway Trains—I.	73
A Question of Public Policy	75
Second Semi-Annual Convention of the N. W. Electrical Association, St. Paul, July 18, 19, 20	77

LEGAL NOTES :—

Value of Services and Stock.—Altenburg & Kiebolte vs. Citizens E. L. & P. Co. of Louisville	64
---	----

MISCELLANEOUS :—

Steam and Electricity in the Poorman Mine	67
Celebrating a Cable Anniversary in England	78

INVENTORS' RECORD :—

Classified Digest of U. S. Electrical Patents Issued July 10, 1904	72
--	----

REPORTS OF COMPANIES :—

Waring Co. Winding Up	78
General Electric Affairs	78
Affairs of The Elec. Mfg. & Gas Engine Co.	78

OBITUARY :—

Edmond Julien	78
---------------	----

PERSONAL :—

Mr. H. A. Foster	78
Prof. T. C. Mendenhall	78

TRADE NOTES AND NOVELTIES AND MECHANICAL DEPARTMENT :—

New General Electric Direct-Connected Multipolar Generator. (Illustr.)	79
—New Heating Apparatus of the Carpenter Enamel Rheostat Co.	79
Allgemeine Elektrizitäts Gesellschaft.—Orders for "M. A. Green" Engines.—Harrison Telephones.—The Denver Messenger Call System.—Westinghouse Stopper lamps.—New York Notes	80

SUBMARINE CABLE ACTIVITY.

THE recent Intercolonial Conference, at Ottawa, drew attention to the fact that though the world has 153,649 nautical miles of cable, it needs more, some of the heaviest work remaining to be done. Even in the North Atlantic, where already ten cables carry the business, the service has just been extended. The Commercial Cable Company now has its fine new cable—the third—in working order; and the Anglo-American Company, not to be outdone, is equalizing matters by laying down its fifth. The work has become very expeditious; to lay the deep sea portion of the Commercial Cable No. 3 occupied the "Faraday" only 12 days. A little table given in this issue summarizes the growth and extent of Atlantic telegraphy. One dozen cables would seem to be enough there, but there must be some relation or ratio between their number and the increasing population and trade; so that in 1944, two dozen may not be excessive, unless a better way of communication has been found, between Europe and America.

When, however, we turn our eyes away from the Atlantic to the Pacific, we discover even larger opportunities for cable laying, opportunities to which the Ottawa Conference has drawn attention in a very forcible manner. Nay, more, for it was wisely insisted by delegates from South Africa, that communication by cable was already necessary between Australia and the Cape, if not merely for business, at least for the military, naval and strategic purposes of a people who own a modest quarter of the globe and are apparently desirous of retaining it. Compared with the Atlantic, as shown by any cable map, the Pacific is strikingly bare of cable service, but the Indian Ocean is not much better, if we except what may be called the coast lines of the Eastern and Eastern Extension, looping into every possible port and island from which a revenue can be derived. If one looks at a cable map, it will be seen that a message from Lima to Cape Town, or one from Rio de Janeiro to Melbourne, has some very erratic traveling to do.

With regard to the Pacific, however, we are now within measurable distance of having the cable there that is so badly needed, from the western shore of this continent to Australia and all the South Seas. But this day (July 19), our papers gave the news from Auckland, dated July 18, that on July 4, the new Republic of Hawaii was proclaimed, with Mr. Dole as its president. All the Hawaiian news, including much of greater importance, has been subject to similar exasperating delay; and if we cannot have an American cable, the sooner we have a good English one, the better. The traffic between this country and the Dominion, and the other countries across the Pacific, needs this cable and must have it. We publish in this issue a statistical statement from Mr. Alexander Siemens showing the scheme—or one of the schemes—to be both physically and financially feasible; and if this be so, it cannot be too quickly carried out. It is true that no less an authority than Sir John Pender thinks it difficult for the new cable to pay its way; but Mr. Siemens presents some very encouraging figures to the contrary, and we may add, from our personal knowledge, that many of the Intercolonial delegates were ready to pledge substantial support to a plan that would at once give Aus-

tralia and New Zealand an alternative cable route to Europe and unite them to the whole of the North American continent, with which their relations become daily more intimate and beneficial. It will be observed that Mr. Siemens considers the project to require about \$10,000,000, for four sections of cable, steamers, buildings, instruments and working capital; against which he places an estimated revenue of \$1,100,000 per annum, or 2,200,000 words at 50 cents per word, the cable having a recorder capacity of 7,000,000 words per year. The present Australian cable traffic is said to run about 1,306,716 words at 75 cents; but that is hardly a criterion for the share that would preferably come this way and for the new business now awaiting development. To us it seems that the rapid growth of the United States will remain a leading factor in the question even if it be an English cable, as it probably will. The English colonies will grow, but their rate is kept down by the fact that their accessions of population are limited almost entirely to people of English birth. There is no particular reason why a German, an Italian, an Austrian or a Slav should colonize under the English flag, and very few of them do so. They, as well as a great many English, prefer to come to this country, less now than in prosperous times, but always in great streams of hopeful, vigorous humanity; and the result is that, alongside the rate of growth of the United States, the rate in the Dominion and other portions of the Empire is relatively small. Hence the gain of the United States in wealth and population and the advance of the States on the Pacific Slope makes our interest in a Pacific cable considerable; and our Asiatic and Australasian trade will do much to render its success sure.

POLITICAL OR PRIVATE MONOPOLIES OF PUBLIC SERVICE?

IN these days of public disquiet, socialistic agitation, frenzied outbursts of discontent and renewed demands for Government ownership and management of various industries, Mr. Allen R. Foote's paper,—*Shall Public Service be Rendered by Political or Private Monopolies?*—read before the Northwestern Electrical Association, at St. Paul, last week, is specially pertinent and timely. We print an abridgement, in other columns, regretting that we have not space for the entire paper. The question of municipal ownership of lighting plants has been much discussed at electrical conventions and Mr. Foote's views have become well known among electrical people, through his addresses and writings. Companies supplying electricity for public service form, however, but a modest fraction of the mass of industrial investment sought to be "nationalized" or municipalized by many agitators and reformers, some of whom are educated men and a few of them college professors.

Mr. Foote addresses himself to the general subject of public services that are by their nature properly monopolies, and contends—against the Socialistic theorists, and particularly Professor Ely, sometime of Johns Hopkins, now instructing the youth of the west at the University of Wisconsin—that private monopolies, under governmental control and regulation, national, state or municipal, will best promote the public welfare. He restricts his argument to the economic aspect of the question, that is to say, to the probable gain or loss of the people who pay

for various public services—the general public—in nowise urging any traditional or sentimental considerations. He admits that political monopoly should be resorted to if it could be shown that the cost of such services as transportation, water supply, telegraphing, lighting, etc., would thereby be reduced to the public. But this can never be shown until statistical comparisons are made between the working of municipal and private plants in the same service, based upon an identical schedule of expenses and system of accounting, and putting both on the same footing as to immunities and privileges. In behalf of those who still believe in the greater efficiency and economy of private enterprise in all industries Mr. Foote challenges the advocates of nationalism and socialism to such a test. Experience furnishes presumptions wholly against the relative economy of government or municipal work in any field. It would be folly to transfer to the national, state and municipal governments the ownership and administration of the vast properties now employed in public and quasi-public services by corporate and individual owners until an economic gain thereby can be proven or shown to be probable.

POWER TRANSMISSION IN CALIFORNIA.

REFERENCE has already been made in these columns to the project of transmitting power electrically from Clear Lake to San Francisco, a distance of 75 miles, and the directors of the Clear Lake Electric Co. now issue their first annual report giving further details of this interesting scheme. It is proposed to run three lines of steel pipe of 5 feet average diameter a distance of 40,800 feet to the generating house, where the water delivered under 454 feet head at the Pelton wheels will furnish a total of 28,950 h. p. At 72 per cent. loss, this would net 20,845 h. p. in San Francisco. It is proposed to employ 1,000 h. p. generating units and 25,000 volts E. M. F., on the line; and two pole lines each carrying 10 circuits. Besides the pole line, a pipe line across San Francisco Bay and Benicia Straits will be necessary; and 25 miles of conduit for distribution in the city. The cost of the hydraulic plant is put at \$1,005,197 and of the electrical plant complete with all circuits, \$2,931,680, making a total outlay of \$3,936,877, or, say, \$4,000,000 in round figures. Fuel is costly in San Francisco and power costs \$10 per horse power per month. The Clear Lake Co. intend to sell at \$5 per month, which would yield \$1,200,000, or deducting all expenses of operation, \$900,000. This means over 20 per cent. on the investment, which is a handsome figure, and would be excellent even if it were cut in two. It makes no allowance for power consumption at intermediate points. It is stated that San Francisco with its 300,000 population, is now ninth in the Union in manufactures despite the high cost of fuel, and that its manufactured products last year were worth \$83,000,000. Its power plants aggregate 60,000 h. p. The conditions are favorable, therefore, for a large utilization of cheap water power from a distance, and as the climatic conditions are also good, there is no reason that we can discover, on the surface, why the Clear Lake transmission should not prove quite feasible in every way. California has already given us some admirable examples in this new field of electrical enterprise. The Company are watching the work at Niagara, and intend to start at about one-third of their ultimate capacity.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS
ISSUED JULY 10, 1894.

Alarm and Signals:—

Danger Signals for Railway Crossings, M. W. Parrish, Detroit, Mich., 522,670. Filed Oct. 30, 1893.

Device for Preventing Railroad Collisions, C. Holtmann, and N. Schmidt, Pittsburgh, Pa., 522,757. Filed Nov. 14, 1893.

An electric block system automatically controlling the brakes of railway trains.

Electric Signaling Apparatus, J. Coleman, Swissvale, Pa., Reissue 11,423. Filed Dec. 5, 1893.

An electric automatic block signal system for steam railways.

Conductors, Conduits and Insulators:—

Insulating Composition, J. L. Truslow, Jr., Summit, N. J., 522,745. Filed July 27, 1893.

Consists of ground cork and infusorial earth with a binder of resin.

Distribution:—

Electric Distribution-Box, O. D. and M. A. Kleinstenber, Milwaukee, Wis., 522,664. Filed April 5, 1894.

Current-Separator, L. F. Johnson, Poughkeepsie, N. Y., 522,687. Filed April 7, 1894.

Especially designed for connection to lighting circuits in series, and so arranged as to throw more or less resistance into the shunt from the lighting circuit and to permit secondary shunts around such resistance.

Dynamoes and Motors:—

Dynamo-Electric Machine, L. Bell, Lynn, Mass., 522,586. Filed Sept. 19, 1893.

Employs coil chambers, teeth and channels in the adjacent faces of the armature and field magnets of such shape and so arranged that the reluctance of the magnetic path through them shall be kept constant during rotation.

Controller for Electric Motors, J. B. Blood, Lynn, Mass., 522,581. Filed Dec. 18, 1893.

Claim 1 follows:

A switch or controller for electric motors adapted to start the motors in one direction and regulate their movement from rest to highest speeds, and in the reverse direction to start and cause them to operate at lowest speed, only.

Means for Regulating Alternating Current Motors, E. M. Bentley, Boston, Mass., 522,530. Filed April 17, 1893.

Claim 6 follows:

The method of changing the relative phase periods of primary and secondary alternating currents through the primary of a transformer, so as to produce a movement in the line of the polarity of its core and shifting the points of connection of the secondary relatively to the said line of polarity.

Motor Safety Device, A. W. K. Pierce, Plymouth, Mass., 522,851. Filed Oct. 23, 1893.

Employs a shunt around the field circuit comprising a non-inductive resistance, a switch controlling the main circuit, and an auxiliary switch in the shunt circuit controlled by the main switch.

Insulated Armature Coil, J. H. Shugg, Boston, Mass., 522,859. Filed April 21, 1894.

Galvanic and Thermo-Electric Batteries:—

Galvanic Battery, L. F. Johnson, Poughkeepsie, N. Y., 522,535. Filed April 7, 1894.

Employs an electrolyte composed of sulphuric acid, water with chromate of calcium dissolved therein, and nitric acid; the ingredients being unmixed and arranged in the order named.

Heating:—

Electric Heater, H. W. Leonard, New York, N. Y., 521,718. Filed March 28, 1893.

Employs a thinly insulated conductor embedded in a closely applied mass of metal. (See page 79.)

Lamps and Apparatuses:—

Electric Arc Lamp, M. S. Okun, New York, N. Y., 522,699. Filed Sept. 21, 1893.

Employs a globe enclosing the carbons and having a valve to allow the escape of gases, but preventing the passage of air and permitting a lateral motion of the carbons.

Electric Lamp Holder, M. P. Mayer, Rochester, N. Y., 522,690. Filed Feb. 27, 1894.

A combined socket reflector and guard for incandescent lamps.

Electric Arc Lamp, P. Kirkgaard, Brooklyn, N. Y., 522,735. Filed Sept. 28, 1893.

Relates to certain details of construction of the carbon holder and the feed mechanism, dispensing with the dash pot.

Electric Arc Lamp, E. F. Gwynn, Delaware, Ohio, 522,790. Filed April 28, 1894.

Relates to certain details of construction of the feeding mechanism.

Hanger for Electric Lamps, H. C. Henley, St. Louis, Mo., 522,895. Filed July 27, 1893.

An insulated hanger adapted to be screwed upon a gas pipe.

Measurement:—

Electric Meter, G. A. Scheffer, Peoria, Ill., 522,674. Filed April 2, 1894.

Claim 2 follows:

In an electric meter, the combination of a stationary multiple-polar magnet, provided with three polar or magnetic surfaces and a metallic cylindrical rotating armature magnetized thereby.

Electrical Measuring Instrument, E. Weston, Newark, N. J., 522,948. Filed Oct. 3, 1893.

Claim 1 follows:

In an electrical measuring instrument, a vibrating lever, a coil supported on one arm thereof, a fixed coil in inductive proximity to said movable coil, a means of equilibrating said movable coil and a spring opposing the vibration of said lever.

Wattmeter, E. Weston, Newark, N. J., 522,949. Filed April 26, 1893.

The coil spring which counterbalances the movement of the movable coil is also employed to lead the current to the coil so that no manual interference is necessary to produce equilibrium between the fields generated in the coils.

Electrical Measuring Instrument, E. Weston, Newark, N. J., 522,950. Filed Feb. 24, 1894.

Claim 1 follows:—

The combination with a wall or support of an electrical measuring instrument, movable about a pivot on said support, and means for adjusting said instrument so that its face may be disposed at various angles to said support.

Miscellaneous:—

Electrolytic Diaphragm, I. L. Roberts, Brooklyn, N. Y., 522,614. Filed Feb. 10, 1893.

Composed of an insoluble non-conducting and non-coherent powder and a gelatinizable binding material.

Electrolytic Apparatus, I. L. Roberts, Brooklyn, N. Y., 522,615. Filed Aug. 19, 1893.

Claim 2 follows:—

The combination with a tube or vessel having three branches or legs of electrodes in the side branches and a mass of salt crystals in the central branch.

Method of Electrolytic Decomposition of Salts, I. L. Roberts, Brooklyn, N. Y., 522,616. Filed Sept. 27, 1893.

The method consists in maintaining by continuous feed the supply of crystals in the anode compartment and in contact with the anode up to the level of the solution in that compartment.

Apparatus for Manufacturing Caustic Alkali, I. L. Roberts, Brooklyn, N. Y., 522,617. Filed Nov. 25, 1891.

Apparatus for Electrolysis of Salts, I. L. Roberts, Brooklyn, N. Y., 522,618. Filed Oct. 4, 1892.

Electrolytic-Decomposition Tank, I. L. Roberts, Brooklyn, N. Y., 522,619. Filed Nov. 25, 1891.

Employs plates of conducting material in electrical connection with the tank and dividing the latter into communicating compartments with an anode in each compartment.

Electric Synchronizer for Clocks, L. Von Orth, Germany, 522,734. Filed May 6, 1893.

Electric Lamplighter, J. O. Chambers, Detroit, Mich., 522,737. Filed Feb. 10, 1894.

Electric Door Opener, H. F. Kell, New York, N. Y., 522,723. Filed Jan. 30, 1894.

Electric Crane, E. Hopkinson, Manchester, England, 522,835. Filed July 21, 1893.

Relates especially to the method of mounting the motor which is similar to No. 522,834, *Electric Locomotive*.

Electrolytic Apparatus, O. Knöfler, Charlottenburg, Germany, 522,890. Filed Dec. 7, 1892.

Electric Belt, W. E. J. Lawlor, Portland, Ore., 522,841. Filed Sept. 14, 1893.

Electric Oil-Lighter, C. F. Reiff and H. Munk, Fremont, Ohio, 522,919. Filed Jan. 26, 1894.

Electric Oil-Lighter, J. J. Eberhard and C. G. Schimkatt, Fremont, Ohio, 522,924. Filed Sept. 25, 1893.

Railways and Appliances:—

Combined Hanger and Automatic Switch for Trolley Wires, R. Scheffbauer, Paterson, N. J., 522,621. Filed July 15, 1893.

Conduit Railway Trolley, J. L. Creveling, Auburn, N. Y., 522,655. Filed April 5, 1894.

Employs two trolley wires one at each side of the same conduit and two trolleys supported on opposite sides of the same supporter.

Contact-Shoe for Electric Locomotives, J. J. Green, Boonton, N. J., 522,700. Filed July 5, 1893.

Comprises a yielding central bar, flexible metallic side strips and end pieces of insulating material.

Contact-Bar for Electric Locomotives, J. J. Green, Boonton, N. J., 522,710. Filed Oct. 9, 1893.

Similar to No. 522,700.

Supply System for Electric Railways, J. J. Green, Boonton, N. J., 522,711. Filed Oct. 9, 1893.

Claim 12 follows:—

A narrow electric conduit having pockets for the electrical connections formed at the side, in combination with covers for the pockets, and contact boxes having switch arms in different horizontal frames.

Electric Locomotive, E. Hopkinson, Manchester, England, 522,834. Filed July 21, 1891.

Employs an armature built upon the axle and magnets and pole pieces suspended beneath the latter from journals.

Trolley-Ear, C. A. Lieb, New York, N. Y., 522,844. Filed April 12, 1894.

Consists of a sheet metal portion with an upwardly extending fold to which is secured a cast metal bolt portion.

Trolley-Wheel, C. A. Lieb, New York, N. Y., 522,845. Filed April 12, 1894.

Consists of a central core of copper provided with steel flanges.

Closed Conduit for Electric Railways, C. I. Greer, Washington, D. C., 522,894. Filed April 16, 1894.

Claim 1 follows:—

In an electric railway, a slot-cover composed of a series of plates of rigid material having central, depending webs which are pivotally linked together.

Trolley-Pole, A. S. McBean, Montreal, Can., 522,915. Filed April 10, 1894.

Employs a metal section at the top of the pole carrying an adjusting platform upon which the trolley wheel is swiveled.

Switches and Cut-Outs:—

Electric Switch, J. Hutchinson, New York, N. Y., 522,597. Filed June 14, 1893.

An electrolifer switch for incandescent lights.

Circuit-Closing Device, P. J. Walsh, Jr., Philadelphia, Pa., 522,632. Filed May 8, 1894.

A window and door spring for electric burglar alarm systems.

Current-Interrupter for High-Potential Circuits, E. Thomson, Swampscott, Mass., 522,835. Filed Feb. 6, 1893.

Employs two separable terminals to one of which is connected a spring actuated drum, and an electromagnet adapted to disconnect the terminals.

Telegraphs:—

Telautograph, E. Gray, Highland Park, Ill., 522,892. Filed March 8, 1893.

Triautograph, E. Gray, Highland Park, Ill., 522,893. Filed Jan. 27, 1894.

Telephones and Apparatus:—

Telephony, F. R. Colvin, New York, N. Y., 522,707. Filed May 22, 1894.

Employs two contacts mounted upon the telephone support which when the receiver is in its normal position are bridged and close the calling circuit, but when the telephone is removed, open the branch and leave only the telephonic apparatus in circuit.

Operator's Telephone Circuit, T. C. Wales, Jr., Boston, Mass., 522,925. Filed Dec. 2, 1893.

Employs an induction coil with a single primary winding included in the local circuit and two secondary windings in circuit serially with the main line conductors together with a branch extending from a point between them to earth, and a receiving telephone in a branch of the local circuit shunting the primary winding.

LEE & COLLINS is the name of a new concern at 65 Lees Building, Fifth avenue, Chicago, composed of C. E. Lee and L. W. Collins. It handles as specialties the Sampson battery, Leavitt motors, Abatis Electric Mfg. Co.'s goods, and the products of the Chicago Gauge Co. It is also marketing the Collins compounds, or paint, for finishing, preserving and insulating metal or wood apparatus.

THE ELECTRIC LIGHTING OF RAILWAY TRAINS.¹—I.

BY M. B. LEONARD.

The railroad world is quite familiar with the various systems that have been tried in this country and abroad to provide electric lighting for passenger trains at reasonable cost, beginning with the Houghton-Stroudley system installed in 1882, on the London, Brighton & South Coast Railway of England, and now quite largely extended, in which a dynamo driven from the car axle, charging a storage battery carried permanently on the car, is used, but this particular system has not, thus far, met with success in the United States, owing to the fact that the English cars have but a single pair of wheels and an axle rigidly attached to each end of the car, thus permitting the armature shaft to be kept parallel to the car axle at all times and a belt connection utilized, which cannot be done on the American style of cars with swinging trucks at both ends of the car. I am informed that no less than forty trains are equipped with this system on the L. B. & S. C. Ry. alone.

The efforts made towards developing a system of car lighting by primary batteries have met but little success in this country, the tests on the New York Central and the Boston & Albany Railroads, in 1887, having been brief and unsatisfactory; though it is stated that a train was run between Paris and Brussels for over a year, the lamps on which were energized by current from a bi-chromate battery. One charge of the battery lasted for five trips of seven hours each without renewal, but no accurate estimate of the expense, nor more detailed information, is obtainable. It would seem that the cost of the zinc consumed, as well as of the battery solution, would make this system of lighting entirely too expensive for general use.

Much interest has been taken in the system so successfully developed by Mr. George Gibbs, Mechanical Engineer of the Chicago, Milwaukee & St. Paul Railway, in which the lamps in the coaches are supplied with current direct, without the intervention of storage batteries, from a 15 k. w. Edison dynamo directly connected to an 18 H. P. Westinghouse automatic engine carried in summer on one end of the baggage cars on two of their through trains, and in the baggage compartment of their combined buffet cars on two others, taking steam from the locomotive and attended to by the baggage master. In winter the equipment is transferred to the special light and heat tenders which are also fitted up for the purpose of supplying steam heat to the train. Nearly 100 cars have been already equipped with 16 c. p. 110 volt lamps and wired on the equipotential system. The number of lamps per train supplied by the dynamo vary from 180 to 235, and the cars have made nearly 196,000 miles each, without a single accident. This system has been giving entire satisfaction, and will doubtless be further extended, though there seems to be one drawback, in that the lighting by the electric current ceases whenever the cars are shifted to or from the train. It has been proposed to remedy this by using small storage batteries supplying a few low voltage lamps in each car, with an automatic switch that throws them in circuit when the locomotive, or the light and heat tender, is cut off from the train. A novel feature of this system is the fixed berth lamps designed by Mr. Gibbs. They are ornamental in appearance, economical in operation, and much more satisfactory than the flexible cord arrangement heretofore used.

The cost of equipment and the present expense of operating the system are said to be, figured on a seven-car train:

For baggage car, including engine, dynamo, switchboard and wiring.....	\$1,250.00
2 coaches at \$127.....	254.00
2 Parlor cars at \$511.00.....	622.00
2 Sleeping cars at \$245.00.....	490.00
Total, per train.....	\$2,616.00
Per car.....	\$74.00

For a seven-car train, comprising baggage or combined car, four coaches, one parlor car and one sleeper, the average cost of equipment would be about \$338 per car, and the expense of operation per trip of 430 miles is estimated as follows:

Attendance on train (½ wages of 2 men).....	\$2.62
Supervision.....	.62
Lamp renewals (3 at 40c.).....	.80
Oil and waste.....	.22
Miscellaneous supplies and labor.....	.20
Interest and depreciation at 10% on cost of train equipment.....	.87
Total.....	\$6.20
or, per car per day, \$0.88; per car per hour, 0.0633.	

If a ten-car train be run, the cost per car hour would be correspondingly less; in fact, it is stated that the cost of labor and repairs of four such trains in 1893 were, per month:

For labor.....	\$650.00
For material.....	175.86; or \$825.86 per month.
Cost per car per day of 9 hours lighting.....	78.6c.
Being for labor.....	61.9c.
material.....	16.7c.
and per lamp per hour approximately ½ cent.	

1. A paper read at the Annual Meeting of the Association of Railway Telegraph Superintendents, Detroit, Michigan, June 14, 1911.

The combined dynamo and storage battery system first introduced by the Pullman Palace Car Co. in 1887, does not seem to be meeting with the degree of success anticipated. Many of the roads upon which it has been used are gradually abandoning it, although during January, February, March and April last, the Pullman company operated 43 cars in this city, 24 on the Florida Special between Jersey City and St. Augustine, and 18 between New York and Chicago on the Pennsylvania R. R., the cost of which is set forth by Mr. A. H. Bauer, Chief Electrician of the Pullman Co., to have been 7½ cent per lamp hour. In his valuable paper read before the American Institute of Electrical Engineers in June, 1892, Mr. Bauer stated the cost of equipping a six-car Pullman train with this system to be:

For Combined Baggage Car, including Brotherhood Engine, and Elckemeyer Dynamo switchboard and wiring.....	\$2,027.80
Three Sleepers, each \$762.50.....	2,287.50
One Observation and Sleeper.....	749.40
One Dining Car.....	743.50
Total cost per train.....	\$5,808.20

Average per car \$968; number of lamps per train 172 of 64 volts, using 98 of 16 c. p. and 74 of 8 c. p. 33 cells of the American Storage Battery Company's 150 amp. hr. type carried under each car in the train; average period of lighting being about ten hours per day.

For labor and material required to light three such trains or 18 cars from August 1890 to February, 1892, a period of 19 months, the average total cost per month was shown to be \$1,265.95, or \$1.99 per car per day. Labor per month, including wages of train electricians and those at terminal stations, was \$712.39. Labor per car per day, \$1.11. Material per month including cost of battery renewals was, \$511.51. Material per car per day, \$0.87; making average total cost per lamp per day 7.17c. varying from 8½c. to 12½c. The item of material varied from 12c. to \$2.04 per day, average being 87c. as stated. The cost of the labor was constant, and did not change.

The system of lighting by the storage battery alone, and charging the batteries at terminal points, has been greatly improved since the first trial of it was made by the Pennsylvania Railroad in 1882, and as regards economy of operation it has, at least on one road, shown as satisfactory results as the Pintsch gas system. The various companies using this method believe that the success is due to the excellence of the particular type of battery installed, and in nearly every case remove the batteries from the cars at the end of the run in order to be charged, thus eliminating the expense of a skilled electrician for each train, and the taxing of the locomotive for steam to operate the plant in the combined dynamo and storage battery system just described.

For lighting by this method, the six parlor cars operated by the Pullman Palace Car Co., between Jersey City and Washington, and four similar cars between Jersey City and Philadelphia, each fitted with 27 lamps of 16 c. p. fed from 32 cells of the American Storage Battery Co's. 150 ampere hour type. I am advised by Mr. Bauer that the expense is as follows:

Cost of equipping each car, including necessary batteries, lamps and wiring \$650, total for 10 cars.....	\$6,500.00
Operation.	
Interest on \$6,500 at 6 per cent.....	\$ 390.00
80 per cent. depreciation on positive plates.....	1,000.00
32 " " " negative ".....	666.66
5 " " " sockets, battery boxes, wires and switches.....	50.00
Lamp renewals.....	40.50
Cost of charging per year.....	350.00
" " labor, handling and repairing batteries, etc.....	600.00
Total.....	\$3,097.10
Cost per lamp per year.....	\$11.47
" " " day of 5 hours.....	3.14
" " " hour.....	.62

On the four cars carrying 26 lamps of 16 c. p. 60 volt, and 32 cells of 150 ampere hour capacity that were operated by the Pullman Company between Chicago and Cincinnati, and Chicago and Indianapolis, the batteries being charged on the cars at the terminal points, obviating the expense and damage in transferring the cells, it is stated that the cost of their operation from Sept., '91 to Jan. '92 inclusive, was \$314.02.

Per month.....	\$32.80
Per day.....	2.09
Per day per car.....	52
Per lamp per day of 5 hours' lighting.....	2
Per lamp per hour.....	MM

The cost of the power used for charging the batteries is not included in these figures, as the engine and boiler were also utilized in furnishing power for other purposes.

The experience of the Chesapeake & Ohio Railway Company in connection with the storage battery system will doubtless prove interesting to those considering the subject. Discarding the combined dynamo and storage battery system, on account of the expense and trouble involved, the management of the company, after a series of tests, decided to adopt the type of storage batteries brought out by the Dayton Manufacturing Company, and made in the manner described in the patents issued to W. L. Silvey.

Digitized by Google

A QUESTION OF PUBLIC POLICY.¹

SHALL PUBLIC SERVICES BE RENDERED BY POLITICAL OR PRIVATE MONOPOLIES?

BY ALLEN RIPLEY FOOTE.

Mr. Foote took for his "text" the following extracts from the platform of the Knights of Labor:—

"X. The abolition of the contract system on national, state, and municipal works."

"XIX. That the Government shall obtain possession, under the right of eminent domain, of all telegraphs, telephones and railroads; and that hereafter no charter or license be issued to any corporation for construction or operation of any means of transporting intelligence, passengers or freight."

Such public services required a special use of thoroughfares, the investment of capital in lands, buildings and machinery, the organization and direction of labor, and the maintenance of systematic operations. Such services would include intra-mural transportation, the transmission of intelligence, the supply of gas, steam, electricity or other agents for light, heat or mechanical power, the supply and sanitary treatment of water and the disposition of all sewage, garbage, dead animals and street sweepings.

A municipal corporation is a political organization created by the State for the purpose of serving the welfare of its citizens through local action. Its legal existence is perpetual. Its authority of direction over its local affairs is exclusive, subject only to the control of the State. The only reason for its existence is, that through such an organization the well-being of its inhabitants may be most effectually served.*

A municipal government was a political monopoly.

Professor Richard T. Ely had said:

There are various undertakings which are monopolies by virtue of their own inherent properties. * * * They are railways, telegraphs, telephones, canals, irrigation works, harbors, gas works, street car lines, and the like. Experience and deductive argument alike show that in business of this kind there can be no competition, and that all appearances which resemble competition are simply temporary and illusory. * * * The manner in which they are managed must affect very materially the entire population, and in particular the wage earner. The policy which in the United States has heretofore been pursued with respect to these businesses has been to turn them over to private corporations, and to encourage attempts at competition. * * * A single city like Baltimore has easily wasted \$10,000,000 in attempted competition in the gas business. * * * A change of policy with respect to businesses of the kind mentioned is advocated. It is laid down as a general principle that non-competitive businesses should be owned and managed by the Government, either national, State or local, and that competitive businesses are the domain of private industry. As it is not a question, with respect to the businesses mentioned, whether we shall have competition or not, but only a question whether we shall have private or public monopoly, public monopoly is preferred to irresponsible private monopoly. The history of the world teaches us that private monopoly is a menace to the public. Men are not good enough to be entrusted with such a despotism as that which monopoly confers.*

Professor Ely was in perfect accord with Mr. Foote's views on the following points:

1. That the business of supplying each of the services under consideration was a natural monopoly, and that legislation to be in accord with sound economic principles must recognize it as such.

2. That the question of policy was not whether we should have competition or not, but only a question whether we should have political or private monopoly.

Mr. Foote agreed with Prof. Ely that "Men are not good enough to be entrusted with such a despotism as that which monopoly confers," and adduced the evidence elicited by the Lexow Committee while investigating the government of the city of New York—an irresponsible political monopoly.

The problem would not wait for the coming of perfect men. We must take human nature as we find it and make the best of it that we can. We must choose between political monopolies in the hands of imperfect men—just now known as political "bosses"—and private monopolies, owned and managed by the same kind of men.

Irresponsible political management led to such things as this:

Prof. Mendenhall, in charge of the Coast and Geodetic Survey, has tendered his resignation to the President. It is said that the Professor puts his action on the ground that the Secretary of the Treasury has interfered with the working of the Bureau by the retirement of experts and the substitution of inefficient men to such an extent that it is no longer possible to conduct the Bureau on a scientific basis.*

This illustrated how the exercise of irresponsible political power failed to produce the most perfect results when used by men who are not good enough.

Law, intelligently formulated and inflexibly enforced by public opinion, was the only agent known by which the doings of imperfect men could be held to a standard of perfection beyond their individual capacities. A most exacting control of both political and private monopolies by the State that created them was required.

He denied the correctness of Professor Ely's position when he said:—"As it is a question, with respect to the businesses mentioned, * * * whether we shall have private or public monopoly, public monopoly is preferred to irresponsible private mono-

poly." We should have neither an irresponsible political monopoly nor an irresponsible private monopoly, but they both should be placed under the most perfect and absolute system of State control that can be devised. Until the State could learn how to control the political monopolies it had organized; until it found a way to hold them to an exact accounting for the use of the people's money obtained by taxation; until municipal accounts were kept by a uniform system designed to admit of scientific statistical comparisons between the results of municipal management by all municipalities in a State; until municipal accounts were systematically audited by State auditors; until such accounts showed in all departments of municipal work that as good a return was secured for the money expended by municipal authorities as was secured in the management of similar work by private enterprise, until these reforms were instituted and firmly fixed as the adopted policy of the State, the proposal to increase the business of political monopolies by turning over to them all the business that is now done by private corporations, was based upon a false conception of the true way to serve the public welfare. In municipal as in personal affairs the Scripture applied:—"Thou hast been faithful over a few things, I will make thee ruler over many things," that is—*Until you are faithful over a few things, you shall not be made ruler over many things.*

Prof. Ely said: "It is laid down as a general principle that non-competitive business should be owned and managed by the Government, either national, state or local." Mr. Foote laid down the general principle that *non-competitive businesses should be owned and managed by private monopolies under property guarded franchises or contracts.*

Professor Ely, before the Boston Merchants' Association (1889) had said:—"Cities should pursue a policy looking to the ultimate ownership and management of all local monopolies."

At the annual meeting of the American Economic Association, Washington, D. C., December 26-30, 1890 (Professor Ely, Secretary), Mr. Foote had offered two resolutions, and desired to address the Association on "*Municipal Ownership of Industries*," but was ruled out for want of time. He printed the paper and sent it, January 2, 1891, to every member of the Association. From that paper he now submitted the following extract:—

It is evident, if the economic advantages obtained by the community through the price paid for the service is to decide the policy of municipal ownership of industries, then those who advocate private ownership must accept the issue on this basis and be ready to show that they can and will perform the same service for the same price that the community pays for it, under municipal ownership and administration.

A condition precedent to the settlement of this question is an agreement on what constitutes cost of service under municipal ownership. It was to establish this agreement that I offered the resolutions Saturday evening last, after Professor Henry C. Adams had read his admirable paper on "Statistics as a Means of Correcting Corporate Abuses."

Please notice carefully the wording of these resolutions. They are:—
Resolved, first, That a Committee be appointed to designate the divisions of accounts, and the items to be included in each, that should be kept by corporations performing quasi-public services.

Resolved, second, That said divisions be so made that the effect of each essential economic factor will be shown, to the end that correct statistics may be obtained through a uniform method of accounting, as a basis for intelligent economic discussion and legislation.

We must first agree upon what items constitute cost, then we must see to it that these items are honestly included in all statements of cost. This done, we are in a position to take intelligent action, and may then award the contract to the municipality or to private enterprise, whichever, in the light of the facts so obtained may appear to be to the best economic advantage of the greater number of people, those who toil and are poor.

Assuming that no economist will take issue with me regarding this fundamental basis for an agreement, I will advance one step further and claim, until such a basis is agreed upon and the accounts are made in accordance with its requirements, there shall be a suspension of judgment and action. By adhering to this policy all parties will not only avoid the liability to get into positions from which they will have to recede when the statements of cost are correctly made, but large invested interests will cease to suffer from attacks that would not be made if those who utter such statements were better informed.

I urge this claim upon you for another reason. I, like all not to the manner born, have a lofty ideal of nobility. I feel it to be a personal belittlement to be obliged to lower it. According to my ideal, the noblest men are those who worthily fill the station of teacher. What wonder is it then that I should feel hurt when I see some who occupy such stations giving currency to statements that tend to lessen the respect for, and, therefore, the influence of those who utter them. When professors of economy give currency to statements of cost of production which practical men, in the light of accounts they are daily keeping, know are not true, they must not wonder if they find themselves and the educational institutions with which they are connected held in small estimation. The profession cannot afford this any better than business interests can afford to suffer from the attacks of the uninformed. Here, again, I think, we have a point of agreement. Let us join hands upon it and take as our guide to action: whose cause the truth will not serve is lost. That truth may be established, no statement of a demonstrable fact should be made without an analysis of the conditions to show that the conclusion reached is correct.

Having in part explained my views and position to you, I feel it right to tell you I look upon statistics as being as potent a means of correcting the abuse of corporations as for correcting abuse by corporations. To sustain myself in opposing the principle of governmental ownership of industries, in whatever form it may take, I invoke the same power as do those who favor that principle.

Take the accounts of all the industrial plants owned by municipalities and write them up completely from the date of their initiative until now, and you will find that the communities that have entered upon those experiments have not gained an economic advantage. Private enterprise stands ready to-day to take over every one of these plants and perform the services at the same price such accounts will show it is costing the community where it is rendered, provided the municipality will grant the same economic advantages assumed by itself, which are:

An untaxed investment, an untaxed, exclusive and perpetual franchise.

In the light of this challenge made in 1891, Professor Ely's statement that "It is laid down as a general principle that non-

1. Abstract of a paper read before The Northwestern Electrical Association, St. Paul, Minn., July 19, 1894.

2. Discussion of the Economic Principles Involved in The Law of Incorporated Companies Operating Under Municipal Franchises, page 37.

3. Natural Monopolies and the Workingman.—*North American Review*, March, 1894.

4. *New York Herald*, June 22, 1894.

competitive businesses should be owned and managed by the Government," made in 1894, without qualification, was misleading. That this principle is laid down by socialists was admitted. That it was a sound economic principle, was denied. Since this challenge was given Professor Ely had left the East and found a home in the Northwest as a "Director of School of Economics, Political Science and History, University of Wisconsin." The invitation given Mr. Foote by the "Northwestern Electrical Association" to address it on this subject afforded him an opportunity to re-affirm the challenge in Prof. Ely's new field of labor and to suggest to the patrons of the University that they insist upon its acceptance, to the end that students may be correctly taught.

He did not advocate *irresponsible* political or private monopolies, but monopolies scientifically controlled by well guarded franchises, contracts and a uniform system of accounting. He held that the evils from which the people and corporations have suffered were the results of unscientific legislation enacted by those who through ignorance, prejudice or corruption had sought to strike down capital through attacking monopolies. Their ignorance, prejudice or corruption was proved by the fact that they offered no remedy except to take the ownership of industries away from private capital—individualized, and transfer it to public capital—socialized.

Professor Ely had said :

"The greater proportion of corruption in public life is connected directly or indirectly with natural monopolies. It is absolutely necessary that some control should be exercised over these, but those in charge of these monopolies attempt to escape this control. Sometimes they are unjustly attacked by legislatures, and they use bribery and corruption to defend themselves against injustice; and sometimes they use bribery and corruption to ward off legitimate regulation. Aggression sometimes proceeds from one source and sometimes from the other source, but the result is that we have become involved in a vicious circle of corruption proceeding from monopolistic undertakings."

Corruption was possible only because those who secured election to office by pandering most openly to the ignorance and prejudices of the masses were purchasable when in office. This was so because, if intelligent, it was the lack of principle that enabled them to play the part of demagogues, and, if ignorant, they were not capable of withstanding the intrigues of designing men. The logic of Professor Ely's argument was that those who failed properly to regulate monopolistic industries when owned by private capital, because of their ignorance or dishonesty, would be sure to manage those industries intelligently and honestly when owned by public capital. Who believed this?

Upon one point, and one of far-reaching importance, Mr. Foote was glad to find Professor Ely in accord with his views, viz.: The duty of the State to protect investments that had been made in conformity with the requirements of its enactments could and would not be questioned by any honest-minded person. When these investments were made, the risk of loss of service by competition was taken wherever competition was permitted with private corporations, but the risk of loss of service through a change of policy from private to public ownership was not taken.

Professor Ely had said :—

"The mode of accomplishment (in changing from private to municipal ownership) of course, requires careful consideration, but only a few suggestions can be thrown out at present. One of the most important is that a fair, but never an excessive, value should be paid for the property acquired, and a fair value does not mean simply the cost of duplication of a plant. The policy which has been pursued has been favored by the nation as a whole; and the nation as a whole, and not simply a fractional part of it, should bear the loss. It is largely competition which has led to such enormous expenditures in this non-competitive field, and for this attempted competition the public at large is responsible. If it is insisted that a property should be purchased at the cost of duplication, it makes one part of the community bear the loss due to a false social policy; and, moreover, to urge a hard policy with respect to purchase does more than anything can to defeat the reform."

All praise was due to Professor Ely for the clear manner in which he had stated the right of private owners to compensation for their investment whenever the public should deem it good policy to assume the ownership and management of the business they had been engaged in.

The demand for public ownership of natural monopolies was based upon the fallacy that the profit secured by private contractors or monopolies would thereby revert to labor or to the public. Hence the programme of the Knights of Labor.

There was one economic advantage however, inherent in private ownership, that could not be acquired by a municipality. The operation of this advantage created the profit for which a private company worked. Municipal ownership deprived industry of the economic value of personal interest. This value created the margin of difference between the two systems, all other conditions being equal, and was sufficient for the legitimate profit of enterprise.

The rising tide of socialism threatened to submerge the industrial world and destroy the present civilization. There were indications, however, that the turn of the tide was near at hand. There was a goodly number of municipally owned lighting plants, for both gas and electricity, a proper audit of the accounts of which would illustrate the economic fallacy of municipal ownership to the comprehension of a man less bright than the

average. Those who now entered upon such a policy could do so only because they did not know or would not heed the teachings of experience.

That a change was impending in public policy regarding the control of public-service corporations was conceded by all economists, public men and business managers who were students of the subject. If the change made is to be for the good of the people, individually and collectively, it must be just to corporations.

Mr. Foote looked at the question from the point of view of a broad and sound public policy and asked all who would to adopt and advocate the following brief declaration and statements :

Declaration of Public Policy.

The best interests of the public welfare require, whenever a municipality can obtain a service for the supply of a municipal need, without creating a public debt or the investment of taxpayers' money for such purpose, at a cost to the users of the service not greater than it would cost if supplied from a plant owned and operated by the municipality, by contracting with a private company to supply such service, that the municipality shall have authority to make such a contract in accordance with the best economic conditions. These conditions require, in consideration of the investment of private capital for the purpose of supplying a public service and the organization by the owners of such capital of a company responsible for the proper management and satisfactory supply of such service, that the municipality shall secure to the company by contract, the full enjoyment of economic advantages that shall be the equivalent in every respect of the economic conditions that the municipality would enjoy if it owned and operated on municipal account, a plant for supplying the same service.

Authority for Municipal Ownership of Plants Supplying Public Services.

A municipality shall have authority to acquire the complete ownership of any plant owned by a private company and operated by it under contract with the municipality for supplying a public service, by paying the full value of the same when judicially determined, whenever it has been demonstrated beyond a reasonable doubt by judicial investigation, that an economic gain for the public welfare can be secured by such action, sufficient in amount to justify such change in public policy, and then only.

To Safeguard the Public Welfare.

To safeguard the public welfare, all contracts made under authority of this provision shall stipulate that the company is to erect and to extend its plant so as to supply the service, in the best known manner and at the lowest practical cost to the users of the service, to every section of the municipality whenever and wherever the municipal authorities may from time to time require; that it shall fix its charges for the public, commercial and private use of the service it renders at such rates as shall be only sufficient to cover interest on its outstanding shares of stock and bonds legally issued, at the same rate the municipality pays on its bonded debt, a reasonable allowance for the depreciation of the value of its plant from use, accidents, and contingencies, all operating expenses and the value of all material consumed in the processes of operation and ordinary repairs, and a net profit for dividends of not to exceed 10 per cent. per annum. All such contracts shall stipulate that the prices fixed by the company for the service it renders shall be subject to review by the municipal authorities at the termination of regular periods of five years each; that the extension of the service plant, the adoption of improved apparatus, methods of distribution, or system of management, designed to render the production or final use of the service better or more economical, may be required by the municipal authorities at any time.

To Safeguard the Welfare of the Contracting Company.

To safeguard the welfare of the contracting company, contracts shall stipulate that no extension of the service plant, change of apparatus, method of distribution or system of management shall be required by the authorities of a municipality unless the rate of charges for services rendered and the income from the same, actual or prospective, be sufficient to fully pay the considerations for service rendered herein specified, but the contracting company may consent to make extensions or changes of any kind whenever requested to do so by the municipal authorities, without reference to the effect such changes may have upon investment in relation to income.

To Safeguard the Mutual Welfare of the Public and of Contracting Companies.

In case of a disagreement of any kind between the authorities of a municipality and a contracting company, such disagreement shall be settled by a Board of Arbitration selected for the special purpose, the company naming one, the municipal authorities naming another, and the two members so selected naming a third, the findings of the Board of Arbitration so selected to be final and binding upon the company and upon the municipality.

5. *North American Review*, March, 1894.
6. *North American Review*, March, 1894.

SECOND SEMI-ANNUAL CONVENTION, NORTH-WESTERN ELECTRICAL ASSOCIATION.—ST. PAUL, JULY 18, 19 AND 20, 1894.

With the thermometer registering 94 degrees in the shade and scarcely a breeze to disturb the heat-laden atmosphere, the North-western Electrical Association commenced its second semi-annual session at the Hotel Ryan, St. Paul, on Wednesday, the 18th inst. The rather uncomfortable temperature, however, did not seem to materially detract from the enthusiasm of the members and their friends, as was shown by a liberal attendance. July 18th, at 11 a. m. the convention was called to order the chairman, Mr. Baker, for the purpose, as he explained, of holding a preliminary meeting, the regular meeting to convene in the afternoon. On motion the hours of meeting were set at 2 p. m. and 9:30 a. m. respectively. On motion of Mr. Debell it was the sense of the meeting that members of the press be requested to obtain all their information, as far as it pertains to the proceedings of the association, from the secretary. At 2:30 p. m. the regular meeting was called to order. After roll call (which showed quite a number of the members absent) the reading of the minutes of the last meeting was dispensed with. Applications for membership were received from the following:

Patton, H. A., Gull, H., Sanford, W. B., Huey, Arthur S., Harding, J. H., Cooke, Chas. S., Marshall, Chas. S., Pomeroy, J. S., Markle, Jno. R., Sullivan, M. J., Gregory, Chas. E., Donohoe, F. E., Woodruff, H. S., De Land, Fred., Burch, L. W., Cuno, Chas., Robertson, J. S., Rantfrew, W. E., Daniell, Ed., Morgan, H. B.

Action on above was deferred for time being.

Report of standing committee was also deferred.

MR. W. B. BAKER moved that the secretary be voted a salary. This caused quite a spirited discussion, the result being that the matter was referred to a committee of three, consisting of Messrs. Collins, Stewart and Norcross, to report at morning session.

PROF. SHEPARDSON not being in attendance, the reading of his paper was temporarily dispensed with and a paper prepared by MR. JOHN C. McMYNN was read by Mr. DeLand, the title being: "On Economy in The Boiler Room." The discussion of the paper was participated in by Messrs. Rau, Markle, Debell, Grover, and proved very interesting. A recess of ten minutes was then taken, after which the programme prepared by the entertainment committee for Friday was announced by the chairman.

PROF. SHEPARDSON next read his paper on "Relation of Technical Schools to Electrical Industries," and was received with great applause by the audience. A spirited discussion followed, participated in by Messrs. Stewart, Brooks, Sullivan, Norcross and Thorn. A committee on resolutions was next appointed, consisting of Messrs. Norcross, Marceau and Terry.

On motion of Mr. Stewart, Prof. Shepardson was unanimously elected an honorary member of the association.

The meeting then adjourned till 9:30 A. M., July 19th.

THURSDAY, JULY 19.

The meeting was called to order at 10 a. m. by MR. E. L. DEBELL, chairman, the president, MR. PAGE, not having arrived. Additional applications for membership were received from the St. Paul Gas and Electric Light Co., Mr. W. P. Fitch and Mr. G. M. Newton. It was moved that the secretary cast the ballot for the election of all applicants. Carried.

The committee on secretary's salary reported and recommended that the secretary be allowed a salary of \$75 per annum. Moved and seconded that report be accepted and adopted. Carried.

Report of standing committees being next in order, the secretary reported that the committee on schedule of rates were unable to prepare a complete report on account of lack of time. On motion of Mr. Norcross the committee was granted further time and authorized to compile a report for next annual meeting and to have 500 copies of same printed.

MR. B. J. ARNOLD then read his paper entitled "The Cost of Producing Electrical Energy." After the reading of same, a spirited discussion took place, being participated in by Messrs. Markle, Cuneo and others.

After a recess of ten minutes MR. CHARLES H. CHALMERS, Electrician of the D. & D. Electric Co., presented a paper on "The Modern Dynamo."

The secretary then called for the payment of dues by the members, after which the convention adjourned till 2 p. m.

AFTERNOON SESSION.

The meeting having been called to order, MR. C. K. STEARNS read his paper on "Economical Operation of Electric Plants from an Electrical Standpoint," after which a lively discussion ensued, which was taken part in by Messrs. Stewart, Thom, Cuneo, Rau, Grover and others.

MR. A. D. PAGE then read a paper on "Incandescent Lamps: Their Use and Abuse." This paper proved very interesting and was fully discussed by Messrs. Stewart, Markle, Norcross, Thorpe, Thom, Arnold, Kammeyer and others.

MR. ALLEN R. FOOTE then read his paper entitled "A Question of Public Policy," which proved very interesting, so much so that

upon motion it was decided to have the secretary have the paper printed in pamphlet form for distribution among all legislative bodies interested in municipal ownership of light and power plants. The secretary was also instructed to secure a sufficient number of copies of all journals giving the various papers in full, to be distributed according to his discretion.

Upon motion of MR. PLINY NORCROSS the following were unanimously elected honorary members of the association: Messrs. A. D. Page, John C. McMynn, B. J. Arnold and Allen R. Foote.

Letters and telegrams from members unable to attend were then read by the secretary, after which a resolution of thanks to the various committees was offered by Mr. Mercein and adopted unanimously. No further business being before the meeting, the convention adjourned to meet at Milwaukee next January at the regular annual meeting. The third day of the convention was taken up by the members in responding to the various invitations of several local concerns, the feature of the day being an excursion to Minnehaha Falls tendered by Mr. Morgan Brooks of the Minneapolis Engineering Co. The General Electric Co. jointly with the Babcock & Wilcox Co. gave a very enjoyable excursion on the night of the 19th to Lake Harriet.

Among those present were the following:

CHICAGO.—Stedman, J. F., Bunce, A. C., Wheaton, M. C., Morgan, H. B., Gregory, C. E., DeLand, Fred., James, J. B., Donohoe, F. E., Wilson, Wm., Lowe, W. W., Sullivan, M. J., Sullivan, Mrs. M. J., Markle, J. B., Neiler, S. G., Terry, B. S., Arnold, B. J., Cooke, C. S., Burch, L. W., Gage, C. F., O'Hara, B. F., Kammeyer, C.

CLEVELAND.—Miles, B. F., Pomeroy, F. S.

SPARTA, WIS.—Newton, G. M.

MASON CITY, IOWA.—Fitch, W. P.

GREEN BAY, WIS.—Collins, Carroll.

JANESVILLE, WIS.—Norcross, Pliny, Norcross, E. P.

LACROSSE, WIS.—Amundson, H.

MADISON, WIS.—Thorne, H. C., Thorne, Mrs. H. C.

MILWAUKEE, WIS.—Rau, O. M., Andrae, H.

MENOMINEE, MICH.—Daniell, Ed.

MANKATO.—Brown, R. E.

MINNEAPOLIS.—Stewart, W. M., Bruce, Robt. W., Brooks, Morgan, Hardy, J. W.

NEW YORK, N. Y.—Howell, W. S., Gage, A. D., Bell, J. Lee.

OCONOMOWOC, WIS.—Cuno, Chas.

ST. PAUL.—Clausen, O., Bonwell, W. J., Bradbury, F. S., Schoenleber, J. J., Huey, A. S., Stearns, C. K., Wilson, Chas.

SHEBOYGAN, WIS.—Debell, E. S.

SIOUX CITY, IOWA.—Woodruff, H. O.

WAUWATOSA, WIS.—Grover, F. F.

WAUPAKA, WIS.—Baker, W. B., Lord, Irving P.

WASHINGTON, D. C.—Foote, Allen R.

CONVENTION NOTES.

The very neat and attractive badges were provided by the irrepressible Mr. Bunce of the General Electric Co.

THE GENERAL ELECTRIC Co. had a very attractive exhibit of their various appliances in the corridor of the hotel.

THE BABCOCK & WILCOX Co., by their manager, Mr. Charles Wilson, exhibited a working model, also sections of tubes and headers of their well known boiler.

THE ELECTRIC APPLIANCE Co. had quite an exhibit of specialties handled by them, one of the most attractive of which, to a majority of the members, were several boxes of "Paranite" cigars.

MR. LOREN W. BURCH was in charge of the Metropolitan Electric Co.'s exhibit.

THE SWAN MANUFACTURING Co., of Cleveland, were represented by Mr. J. G. Pomeroy who showed a complete line of sample lamps.

MR. FRANCIS E. DONOHOE, Western Agent of the American Electrical Works, was extolling the merits of his company's products in an able manner.

THE WESTERN ELECTRIC HEATING Co., of St. Paul, had a very complete line of electrically heated household appliances.

CHARLES E. GREGORY, of Chicago, who goes under the sobriquet of "Damaged Dynamos," contributed his share in enlivening the occasion by his funny reminiscences, incidentally distributing his telephone directory of Chicago.

THE PAGE BELTING Co., through their Western Manager, Mr. Josiah Stedman, distributed a neat little souvenir, in the shape of a note book containing some valuable information about belting.

MR. IRVING P. LORD, while at Minnehaha Falls, had the misfortune of being mistaken for a Coxeyite, by one of the guardians of the turf, and was invited to obey the injunction of the "Keep off the grass" sign. As if to add insult to injury, Mr. O. M. Rau of the Milwaukee Street Railway Co., was mean enough to push the button at that particular time, leaving an indelible record of the sad occurrence.

MR. W. H. THORPE, of Beaver Dam, created quite a sensation during one of the sessions by claiming to be too "thickheaded" to see why incandescent lamps after their life of usefulness has passed, should be broken. Mr. Page, of the Edison Lamp Works, assisted by several other members undertook to enlighten the member but gave up the task in despair.

MR. W. M. STEWART, of the Siemens & Halske Company, was universally acknowledged to be an apt illustration of the adage that circumstances alter cases. From a dyed-in-the-wool five wire system man at the last convention, he now has become an enthusiastic advocate of the 220-volt lamp, a sample of which he showed, which, however, turned out to be made by the General Electric Company.

PROGRAMME OF ENTERTAINMENT COMMITTEE, NORTHWESTERN ELECTRICAL ASSOCIATION FOR FRIDAY, JULY 20TH, 1894.

LADIES INCLUDED.

9.00 A. M. Meet at Hotel Ryan, 9.10 A. M. Walk to electric station of St. Paul Gas Light Co., and power house of Twin City Rapid Transit Co., both located corner Washington and Hill streets.

10.15 A. M. Walk to landing foot of Chestnut street.

10.30 A. M. Take steamer "Flora Clark" for excursion on River, tendered by Electrical Engineering Co., Minneapolis. Lunch will be served on board.

2.00 P. M. Land at Minnehaha, and proceed to the Falls. Take special cars provided by the Twin City Rapid Transit Co., to their Minneapolis Power House.

After viewing this Power House the following points of interest will be inspected by members as they choose.

The University of Minnesota Electrical Laboratory, Professor Shepardson in attendance between 4.00 and 5.30 P. M. to show Laboratory.

The Minneapolis General Electric Co.'s "Brush Station," Brush Arc and Westinghouse Incandescent.

The Minneapolis International Electric Co.'s Station, Lumber Exchange, Hennepin Ave. Siemens & Halske plant.

New York Life Building. "Brush Incandescent Isolated Plant."

Journal Printing Co. "D. & D. Motor plant running new printing presses." D. & D. Factory.

S. E. Olson & Co.'s Department Store. "Standard Arc Isolated Plant."

Electrical Engineering Co.'s Store and Offices.

EVENING EXCURSION.

5.30 P. M. Special cars will be provided by the courtesy of the Twin City Rapid Transit Co., for return trip to St. Paul.

The above programme was carried out on the general lines very successfully.

CELEBRATING A CABLE ANNIVERSARY IN ENGLAND.

At the Imperial Institute, in London, on July 20, a meeting was held to celebrate the twenty-fifth anniversary of the laying of the submarine cables to the Far East. Sir John Pender said that the Eastern company's nucleus twenty-five years ago was 900 miles of cables and £260,000 capital. Now it is 51,325 miles of cables and a capital representing nearly £15,000,000. At present, he said, the total mileage of submarine cables was, in round numbers, 152,000 miles, of which 90 per cent. has been provided by private enterprise, costing altogether over £40,000,000. The total length of land wires throughout the world was over 2,000,000 miles, estimated to have cost about £65,000,000. If the cables and land lines were added together a combined capital was represented of £106,000,000. Twenty-five years ago it was considered wonderful to receive a message from India in a few hours. To-day telegrams arrive in a few minutes. They commenced business by carrying at the rate of 400,000 messages per annum. To-day they transmit over 2,000,000. U. S. Minister Bayard replied to the sentiment of "Submarine Telegraphy," in a graceful speech that made fitting allusion to the work of Cyrus Field.

PERSONAL.

PROF. T. C. MENDENHALL, has accepted the presidency of the Worcester Polytechnic Institute, and land for a new president's house has been given by the Hon. Stephen Salisbury, one of the trustees. Worcester is doing good work and should now prosper hugely.

MR. HORATIO A. FOSTER, who is now associated with Prof. George Forbes as his representative in this country, has become the editor of *Electric Power*, which is greatly to be congratulated upon securing such valuable services. Mr. Foster was one of the staff on electrical work of the last U. S. Census, and has long made a close study of electrical technics and statistics.

THE HARTFORD, CONN., STREET RAILWAY CO., has closed a contract with the Westinghouse Co. for 40 cars of the latest type of equipment. When all the new lines are running, about 75 cars will be used. A large number of men are now at work grading and bonding.

OBITUARY.

EDMOND JULIEN.

EDMOND JULIEN, the distinguished engineer and founder of what is known in this country and Europe as the Julien System, died suddenly at his home in Brussels on the 5th day of this month. Mr. Julien was born at Andenne, on the 31st day of August, 1838. He was by profession a civil engineer, and in that capacity built a number of railroads in Russia and Spain. He had the reputation of being of the first rank as a railroad engineer. He amassed considerable wealth in railroad building and embarked almost all of it in the storage battery business in connection with Faure and Phillipart. He built what was probably the first storage battery factory in Europe, at Brussels, and in 1885 his storage battery car took the first prize in mechanical traction at the Antwerp Exposition.

Mr. Julien was very highly esteemed by his fellow citizens at Brussels, and King Leopold knighted him in 1889, making him Chevalier of the Order of Leopold. He was a man of most imposing appearance, being nearly 6 ft. 4 in. in height, and of splendid proportions. He leaves a charming family and a beautiful home in Brussels, where hospitality was expended with a lavish hand. His visit to this country, at the suggestion and invitation of Mr. W. Bracken, is well remembered by many electrical engineers who then had the pleasure of meeting him.

REPORTS OF COMPANIES.

WARING CO. WINDING UP.

The annual meeting of the stockholders of the Waring Electric company was held July 10. The company has done no business since the Edison injunction in January. The majority of the stock is said to be in the hands of Boston parties and in the control of Claffin & Kimball, formerly selling agents of the company. It was voted to wind up the business. The Manchester stockholders opposed this move, but were in the minority. The directors elected were A. D. Claffin, T. M. Walker and M. M. Kimball, of Boston, and John Waring and M. S. Chapman, of Manchester. A. D. Claffin was elected president and treasurer and John Waring, secretary.

The statement presented to the stockholders indicated that the liabilities exceeded the assets. Among the claims was one for about \$8,000 made by Claffin & Kimball for alleged defective lamps. Some of the minority stockholders applied to the Superior Court for a receiver, and on July 12, Judge Prentice appointed C. T. Welles, of the City Bank, Manchester.

Prior to the appointment of the receiver the Mather Electric company placed an attachment on the Waring company's plant for rent. A. H. Thayer has been placed in charge of the factory by the receiver.

GENERAL ELECTRIC AFFAIRS.

A recent Boston "special" in the *Wall Street Journal* gives the following: General Electric people say that the threatened strike of the 200 men in the River mill of the Lynn Works on account of reduction in wages, is not of moment. At present there are employed in all the Lynn works about 1,500 hands full time schedule, and 2,700 men at Schenectady. The supply and new order business of the General Electric now aggregates nearly \$1,000,000 of manufacturing per month. Besides the Chicago Elevated Railroad order, the company has orders for 60 double motor equipments from the Cincinnati Street Railway Co. The dividend period on General Electric preferred has been passed for the second time, but if earnings continue to develop as at present, action looking to the resumption of dividends on this accumulative preferred stock is not improbable.

AFFAIRS OF THE ELECTRIC MFG. AND GAS ENGINE CO.

THE ELECTRIC MANUFACTURING AND GAS ENGINE COMPANY, Greenbush Heights, Troy, N. Y., is to be dissolved. Application has been made for the appointment of a receiver. The order has been granted by Judge Fursman, of Troy. The corporation was formed March 25, 1891. The salary of the president has not been paid for two years, and the total indebtedness of the corporation is fixed at \$47,394.42, of which \$23,600, principal for money advanced, and \$2,746.52 interest, is due to James H. Pratt and his wife. The assets of the company are said to be nearly equal to the liabilities. James H. Pratt has been appointed temporary receiver. Mr. Pratt is a resident of Greenbush Heights, and has given a bond of \$30,000.

THE WESTINGHOUSE ELEC. & MFG. CO., has declared its regular quarterly dividend of 1½ per cent. on the preferred stock.

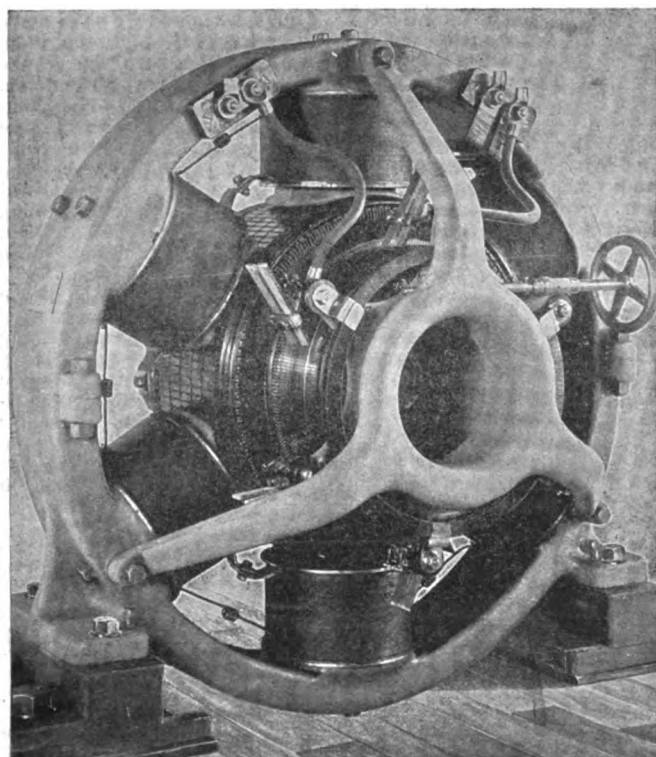
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

NEW GENERAL ELECTRIC DIRECT-CONNECTED MULTIPOLAR GENERATOR.

The new type of direct connected multipolar generator for lighting purposes which the General Electric Company has been manufacturing for some time past with signal success is herewith illustrated. It will be seen that a very large part of the material used is available for magnetic purposes. The magnetic circuits are shortened and a greater output with a higher efficiency can be obtained from a given weight and speed. The shape in itself is an advantageous feature as it allows of a great saving in station space and consequent economy in real estate investment.

The frames and pole pieces are cast from a special soft steel of very high magnetic permeability, and the construction of the armatures is such that a constant current of air circulates through the core and windings and provides the necessary ventilation. The armature windings consist of straight copper bars so connected



GENERAL ELECTRIC DIRECT-CONNECTED MULTIPOLAR GENERATOR.

as to render short circuits or similar troubles practically impossible. The insulation is built up of alternate laminations of tough paper and sheet mica. The machines are designed for very small rise in temperature at full load, the limit on the standard machines being only 40° C above the surrounding air after a continuous run of ten hours, while in the dynamos constructed for the U. S. Government the limit is reduced to 28° C.

The General Electric Company's multipolar generators are divided into two classes, the "smooth body" and the "iron clad," the distinction lying in the construction of the armatures, the field frame remaining the same, with, of course, the number of poles differing with the capacity of the generator. The smooth body armature is used for the larger and the iron clad for the smaller sizes. In the smooth body armature the bars are separated from each other, and the constant circulation of air and the large surface area, render the armature remarkably cool running. The bars connecting the inner and outer winding form the commutator, and as they are an integral part of the winding, the extra resistance from connecting leads and contact surfaces, an important consideration in large machines, is eliminated. Each of these armatures has practically two commutators, one on each side, so that when one has worn down, the armature may be turned around and a new commutator be presented to the brushes, which are all in view of the dynamo attendant from the floor of the engine room. These machines are sparkless.

The iron clad armature derives its name from the manner in

which the core is slotted. When the conductors are placed in the slots they become practically embedded in the body, and thus the iron of the armature, being brought closer to the pole pieces, the reluctance of the magnetic circuit is reduced and the capacity for a given weight increased. The copper, when placed in these slots, is not penetrated with magnetic lines, the total flux passing through the teeth. Large solid copper bars may be consequently used as conductors without loss from eddy currents, and the armature winding becomes an ideally simple mechanical structure. The ventilation, insulation and facility of repair are of similar excellence to those of the smooth body type. The commutators are bolted directly to the body, and a flexible strip connects the sections of the windings with the commutator bars. On the larger sizes the clamping ring holding the commutator bars is made in sections. This allows of all the bars to be held in place with rigidity, and in case of a cross or burn-out of insulation between the bars, only a comparatively small section of the commutator need be disturbed to remedy the defect. The brush holders are all mounted on a spider or rocker arm, and may be all moved simultaneously by means of hand wheels. The brushes are of woven metal gauze.

These multipolar generators are made in sizes ranging from 25 K. W. to 800 K. W., and for speeds ranging from 300 revolutions in the smallest to 90 revolutions in the largest.

NEW HEATING APPARATUS OF THE CARPENTER ENAMEL RHEOSTAT COMPANY.

Mr. H. Ward Leonard has just had issued to him a patent for an electric heater which is likely to mark a very distinct advance in this line. The invention is quite radical, and the patent obtained by him contains very broad claims. The first claim reads as follows: "A device in which electric energy is converted into heat, having a thinly insulated conductor embedded in and completely surrounded by a closely applied mass of metal substantially as set forth."

It is well-known that by sending current through a resistance the entire electrical energy can be converted into heat, and as regards the efficiency of the conversion of electric energy into heat, therefore, no improvement can be effected. The utilization of the heat developed, however, presents great possibilities of improvement. It is very important for the operation of electric soldering irons, flat irons, embossing irons, and many other similar tools, that the heat developed in the resistance shall be conducted to the working surface as rapidly as possible, and with the least amount of waste. In many electrically heated tools, the conductor is surrounded by a considerable thickness of fire-proof insulation such as asbestos, mica, fire-clay, etc., all of which are extremely bad conductors of heat; therefore, if the thickness of the wall of such insulation be considerable, the heat developed in the resistance is conducted but slowly through this bad conductor. The conductivity for heat through such insulation is greatly increased by means of a strong mechanical pressure, but no thoroughly successful results have been obtained in apparatus of this nature. One of the great difficulties was due to the gradual deterioration of the heated resistance, because of its oxidation by more or less perfect contact with the air through the intervening insulation. Thus, in a flat iron, the surface of which comes in contact with damp goods, the heated surface becomes rapidly chilled, unless the flux of heat from the conductor to the heated surface is extremely free and rapid, and with former styles of electric flat irons, in order to maintain upon the surface a sufficient temperature, it has been necessary to maintain the conductor at a temperature very much higher than that of the ironing surface. The necessity of a resistance which would stand a very high temperature has been such that platinum wire is often used in the construction of such tools, the expense of which is, of course, extremely high, but even this has failed under such conditions.

Mr. Leonard has many modifications of the general principles of his invention, but the description of one modification will give a general idea of the invention. The resistance, which is a metal wire, is thinly coated with fire-proof insulation, such as enamel or glass which seals the conductor from the air. The conductor so insulated is placed in a mould, and metal is cast about the insulated resistance so as to completely embed it. This surrounding body of metal as it cools subjects the insulated conductor to strong pressure, insuring perfect mechanical contact throughout. The surrounding metal also hermetically seals the resistance from any possible contact with the air, and from all chemical action. While the insulation surrounding the conductor is of comparatively poor quality, as a conductor of heat, the wall of this insulation is so thin that it affords little resistance to the flux of heat from the heated resistance of the surrounding metal body, and consequently the temperature of the heated resistance and the temperature at the surface of use will be as nearly the same as possible, and the resistance is, therefore, not subjected to a temperature appreciably higher than that of the surface of use. It is claimed to be possible to operate tools heated by the Leonard system at a bright red heat without any destructive effect whatever.

The Carpenter Enamel Rheostat Company, of which Mr.

Leonard is president holding the controlling interest, will manufacture apparatus under this patent. Among the various kinds of apparatus which will soon be on the market, due to this invention, are soldering irons and embossing irons, flat irons and tailors' gooses, cooking utensils such as chafing dishes, broilers, griddle cake bakers, coffee pots, electric stoves, electric ovens, egg boilers, etc., and many applications to small appliances, such as curling irons, sealing wax heaters, etc. Also all kinds of atmospheric heaters such as street car heaters, and heaters for dwellings where the cost of electric current is sufficiently low to make it possible for electric heating to compete with fuel directly. In this regard Mr. Leonard estimates that where power can be had which does not cost more per horse-power per annum than the cost of two tons of good coal, electric heating can compete on the score of economy alone with heat from fuel direct, and the many advantages of electric heaters are so pronounced that they will frequently be applied for atmospheric heating even though the actual direct cost be much greater than that due to heating by fuel.

ALLGEMEINE ELEKTRICITÄTS GESELLSCHAFT.

THE above company, head-offices, 22 Schiffbauerdamm, Berlin, managing director, Herr E. Rathenau, have forwarded to us a superb catalogue entitled: "General Information with Regard to Electric Installations." It is oblong in shape, 12 inches by 9, and is bound in white ivory celluloid, embossed with the company's name and engraved with their famous trademark. On the back is the company's monogram. The four inside cover pages or "endpapers" have beautiful colored maps of Germany, Europe, and the two Hemispheres; while the frontispiece is a choice chromolithograph showing pictures of the company's headquarters, principal factory, lamp works, etc. Then follow about 200 pages devoted to the subject matter of the title, and presenting a vast amount of most useful data. This is supplemented by a variety of illustrations of machines, appliances, plants, etc. The text is printed in blue-black, with red ruling and margins; the edges of the book are rubricated, and there are a couple of braided bookmarks for reference purposes. Everything is carefully classified and grouped and the whole has a complete index to all the parts, which are also arranged alphabetically from A to K. We have seen many handsome catalogues, but never a finer one than this, which does infinite credit to its authors and publishers.

ORDERS FOR "M. A. GREEN" ENGINES.

Mr. Edward F. Austin, contracting engineer, etc., of Pittsburgh, Pa., reports that he has just completed the installment of a 50 H. P. "M. A. Green" engine in Christ's M. E. Church in that city. It is to drive a 500-light Westinghouse dynamo and is the first engine in Pittsburgh in a church for lighting purposes. The "M. A. Green" engine is built by the Altoona Mfg Co., of Altoona, Pa., and has been introduced into the Pittsburgh market by the efforts of Mr. Austin, who, from his first examination of this engine, felt assured of its success, especially for electric lighting and street railway work. He also reports the following sales of the same engine:—One 80 H. P. to the New Castle Car Mfg Co., of New Castle, Pa.; one 150 to 180 H. P. to Jones & Laughlin, of Pittsburgh, to run the electric cranes with which they have recently equipped their mills; two 60 H. P. to the McIntosh-Verner Buildings, Pittsburgh; one 12 x 14 to the Lorch-Eble Machine Co., of Pittsburgh, and one 180 H. P. to the Watson Mining & Mfg Co., of Monongahela City, Pa.

HARRISON TELEPHONES.

THE HARRISON INTERNATIONAL TELEPHONE CO. announces that its construction department, known as the Harrison International Telephone Construction Co., will have its general offices in the Chamber of Commerce Building, Chicago, where all correspondence as to exchanges, purchase or lease of telephones, etc., should be addressed. The parent company, Stephen B. Elkins, president, and Patrick Egan, secretary, will continue as heretofore at 44-46 Wall street. In August the Construction Co. will place on the market its Ford automatic switch, a device for enabling users to call up their communicants without the help of a central. The company publishes a list of testimonials from persons and exchanges using the Harrison telephone apparatus. Among the exchanges included are those at Decatur, Ill., Carlinville, Ill., and Durango, Col.

THE DENVER MESSENGER CALL SYSTEM.

The Universal Electric Messenger Call Company, of Springfield, has been incorporated at Portland, Me., provision being made for a capital of \$100,000. The officers named are: President, B. F. Nichols; vice-president, Henry Denver; treasurer, Dr. E. F. Cross; directors, these officers with E. A. Todd and C. B. Perkins. The company will manufacture a device designed by Henry Denver and others for messenger calls in the halls of large blocks to avoid separate boxes in each office and the wiring they would require.

WESTINGHOUSE STOPPER LAMPS.

THE WESTINGHOUSE ELECTRIC AND MFG. CO., have issued a very interesting little brochure in regard to their stopper lamp. It contains cuts, now familiar, showing details of the lamp, and has one or two nice little views of the lamp factory, one being the glasshouse and the other the machine on which the stoppers are molded. A neat halftone is also given of the "Columbus" illumination in Electricity Building at the Fair, executed in stopper lamps.

Reference is made in the text to the manner in which the Edison lamp patent on the all-glass globe form expires in November, 1894; and statistics are cited in connection with the use of stopper lamps at the World's Fair. With regard to the lamp itself, which has already been illustrated and described in these columns, the pamphlet says:—

"The very wide experience of this Company in the development of the incandescent lamp has given us a thorough knowledge of the requirements for a successful and popular lamp, and the Westinghouse stopper lamp, we offer to the public, feeling confident that it is beyond question superior to any lamp heretofore brought to its notice. Up to the time of the introduction of the two part lamp by this company, the old all-glass type was believed to be the only practicable form, but the perfection, by this company, of a lamp made in two distinct parts, has solved the problem, not only of a better lamp, but one that can be manufactured at a lower cost. In the manufacture of our new lamps we have made radical departures from the old type and it is through the adoption of these changes that it is possible to secure the results attained. The Westinghouse stopper lamp is made in two principal parts, the glass bulb and the stopper which fits into it. Leading-in-wires pass through the stopper and are put in place when the stopper is molded; after the carbon is mounted upon the wires it is inserted in the bulb and the stopper put in place, then the sealing material is applied. The bulb has a pressed or molded neck forming in itself the finished top of the lamp, doing away in standard fittings with the old brass shell or cap, thus simplifying and cheapening the cost of production. The successful substitution of iron or platinum leading-in-wires was accomplished first by this company in the production of the stopper lamp, and, aside from other valuable features thus attained, has made it possible to reduce materially the cost of the finished article to the consumer. By means of the adoption of these new forms it has also been possible to substitute machine work for manual labor to an extent heretofore regarded impossible in lamp manufacture. This fact necessarily insures greater uniformity in our product. To such an extent have we gone into the manufacture in every detail that we can make, under our own supervision, everything connected with the lamp, from the glass bulb to the finished article."

NEW YORK NOTES.

MR. THOS. S. CRANE, M.E., the well-known expert in patent cases, machinery design, etc., has removed his offices recently from Room 74 to Room 180 at 10 Wall street. It may be interesting to note that Mr. Crane has handled over 1,900 applications for U. S. patents during his career as expert and patent solicitor.

MR. C. A. NEWTON, as agent for the Campbell Electrical Supply Co. has opened an office at 88 Chambers street, where he will be glad to show samples of, and receive orders for, "Century" wire, paint and tapes, and other of the well known Campbell specialties. He will represent also their Shaw radial car truck. Mr. Newton has been doing good work for the company in Philadelphia.

MR. C. W. RUSHMORE, 126 Liberty St., reports that his factory in Jersey City is filled with orders for arc lamps, search lamps, commutators and heavy dynamo repairs. He has just closed a contract with the No. Attleboro Steam and Electric Co., of Pawtucket, R. I., to rebuild all of their dynamos damaged by fire last February, and has also arranged to re-build the machines that were damaged in the burning of the station of the Electric Power Co. of St. George, Staten Island. He has also orders on hand for twelve search lamps and mirror projectors. Six search lamps are for the Southern Pacific Steamship Co. who are to equip all of their steamers and a number are for yachtsmen. He has sold a number of special search lamps for the 500 volt railway circuits for exhibition purposes, and is now putting in more special machinery and will take on a dozen more men. Mr. Rushmore states that he is having great success with his new spiral system of winding low tension station dynamos.

Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE Electrical Engineer.

Vol. XVIII.

AUGUST 1, 1894.

No. 326.

THE BROOKLYN, N. Y., NEW FIRE DEPARTMENT HEADQUARTERS.



P. L. Watson.

The city of Brooklyn has lately become possessor of a remarkably fine central fire headquarters, in which is housed a telegraphic department of considerable magnitude, few in this country being its equal in size and amount of work. Of late years the growth of Brooklyn has greatly increased the duties of the Fire Department by including in its field many districts, where wooden construction predominates, and which it was supposed would long remain suburban and semi-rural. Brooklyn, with its population of about one million, occupying an area of 26½ miles, needs to be well served in the matter of fire protection, and it may be said that so far as the electrical part of the system goes, no expense or trouble has been spared to render the equipment adequate to the calls upon it.

The general principles of fire telegraphy have long been familiar to our readers. The apparatus employed in Brooklyn is that of the Gamewell Fire Alarm Telegraph Co., now used by over 600 towns and cities in this country and Canada. The central office outfit was planned and furnished under contract for Brooklyn by the Gamewell Co. The elec-

erintendent of fire telegraphs, adjoining. The battery room shown in Fig. 2, provides capacity for storing and using about 2,000 standard cells of gravity battery. There are at present 9 principal stands, about 3 feet apart, in which stand some 1,600 cells, each held in a neat porcelain support, in the centre of which is a small hole for drainage should any cell overflow or crack. There are also a number of smaller racks for Samson battery for testing the alarm circuits, and a 50-metallic circuit plug switchboard, with standard galvanometer for battery testing purposes, Fig 3.

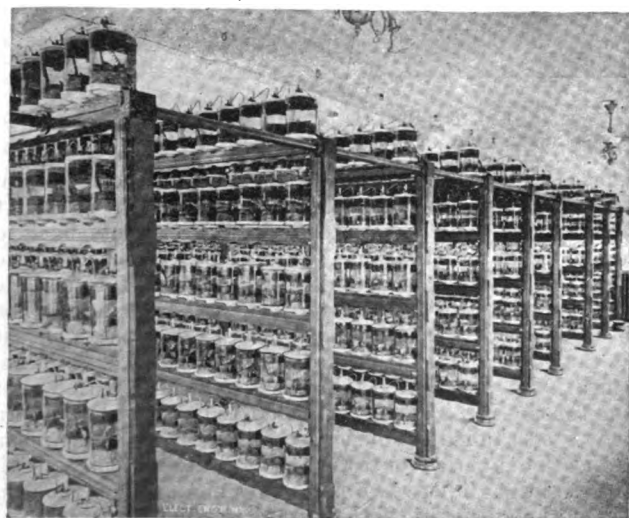


FIG. 2.—BATTERY ROOM FOR 2,000 CELLS.

trical department at headquarters occupies the upper stories of the beautiful building here shown, Fig. 1, constructed of pressed brick and terra cotta. It consists mainly of two large rooms—the battery room and the operating room, with the office of Mr. P. L. Watson, the well-known sup-



FIG. 1.—NEW HEADQUARTERS, BROOKLYN FIRE DEPARTMENT.

The floor is of stone, and the wires are conduited in proper channels under metal strips to the adjoining operating room. The whole battery equipment is in admirable order, and most carefully looked after. It would appear that in such work, opportunity might be found for dynamo current, to replace that from batteries; and the change has, indeed, been tried in Boston; but Mr. Watson expresses himself as being for the present decidedly in favor of existing methods, as absolutely safe and sure.

The operating room shown in Fig. 4 is a fine apartment, of ample proportions, richly fitted up in mahogany, and equipped with all the latest boards, registers, repeaters,

transmitters, testing instruments, etc., as well as the detail apparatus for 60 metallic circuits, 50 of which are for the extensive signal box system and 10 for the alarm system. Our illustration shows the general disposition of the room.



FIG. 3.—TESTING BATTERIES AND TESTING BOARD.

The main switchboard is built up of marbleized slate an inch thick, finished in colors, and arranged for all the various changes and commutations of the circuits brought to it or leading away from it. As has been stated, the metallic circuit is used, but provision is made for working on a grounded system should occasion arise to operate temporarily in that manner. Fifty circuit changing switches are provided, with auxiliary arrangements to transpose batteries and circuits, and there is a main transferring switch so arranged that, if the emergency occur, by one movement the entire system of outside circuits can be thrown off the headquarters we are now describing, at 365-367 Jay street, and transferred to a supplementary office at 268 Jay street.

The main instruments comprise a fine 51-pen combination register, working with 51 sets of magnets and 51 separate inking pens, one of which marks in a different color for "tell-tale" circuits. This pen accommodates paper 10 inches wide. There is also a 10-pen combination register used in recording automatically on the alarm circuits all signals or alarms as they are sent out to the

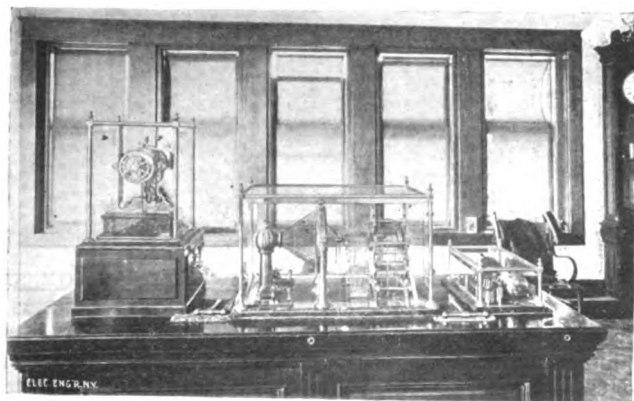


FIG. 5.—AUTOMATIC CIRCUIT TESTER, CHIMES AND CITY HALL BELL TRANSMITTER.

different engine houses. The next important piece, shown in Fig. 5, is the automatic signal circuit tester. This is a beautiful piece of mechanism, in circuit with the clock seen on the right hand, and by its means any ground escape is detected or registered on any of the 50 signal circuits, the

apparatus operating automatically every 20 minutes. A notable feature is that all the parts are in sight and accessible, the practice hitherto being to put the mechanism in the base of the checking clock. This handsome apparatus is mounted on a mahogany table and encased in plate glass, the circuits being brought up neatly through the hollow metal standard behind the circle of contact strips. The record is made on the tape in front of the winding mechanism. Adjoining this, in the central space of the floor, is a 12-dial combination alarm circuit transmitter for 10 metallic circuits. Each dial is arranged so as to be set separately and is capable of sending over the wire any combination of three figures from 10 to 999 or of sending continuous beats from 1 to 200. The main dial will run as many rounds as may be required. This transmitter, or repeater, has two sets of combination cylinders with heavy platina contact plates adjustable to any desired time interval between the different circuits. This apparatus is beautifully made, is mounted on mahogany and marbleized slate and finished in nickel and plate glass.

Brooklyn, it may be mentioned still retains the mediæval habit of ringing a fire alarm from the City Hall, a practice



FIG. 6.—SPECIAL TELEPHONE BOARD.

that was well enough when everybody in the little town lived within earshot of its "Bow-Bells;" but it is hard to see what good the alarm can do to residents back of Ridgewood or out Flatbush way. However, it is part of the system, and Mr. Watson's apparatus therefore includes a 3-dial transmitter for a tower bell striker, timed to beat one blow every three seconds, but fitted with an adjustable fan so that it can be slowed down to strokes of half minute interval; while there is also a combination apparatus for ringing a chime of bells, ten in number, of different tones, tuned to musical scale, and arranged by means of electro-magnetic control to work automatically in the alarm circuits. These two pieces are mounted on the same table as the automatic signal circuit-testing apparatus.

Additional to the signal circuit testing apparatus, there is a 10-circuit testing instrument for the alarm circuits. The main switchboard also carries 60 circuit drop annunciators arranged to be restored both automatically and manually; and there are also 60 Breguet galvanometers, banked together, their deflections showing the ground escape of the respective circuits; while above them is a large "free-for-all" galvanometer, which indicates at

all times the condition of the battery and lines, having a ground switch for the purpose of detecting leaks or escapes. Besides these there is a large dial which shows the last box sending in an alarm; and 4 similar indicators are placed in the rooms of the Commissioner, Deputy Commissioner, Chief Engineer and Public Office, each showing, upon each alarm of fire, the number of the box pulled. The board has, beyond the apparatus already named as constituting its equipment, a three-needle annunciator, with three others also located in official departments; 5 sounders; 60 Morse keys; 50 26-ohm relays in banks of 5, and plug switches, lightning arresters, &c., galore. Daily testing by bridge and rheostat is carried on and duly recorded. At the top of the long section of the main board

through 299 streets. There were in operation 539 public street fire-alarm signal boxes and 129 private boxes, while the extension of the city required at that time the installation of 32 more public boxes, since put up. Over this system, the Bureau received and transmitted 1,368 alarms of fire, of which 99 were still alarms, 1,179 single alarms, 62 second alarms, and 28 third alarms. In addition to this, the Bureau received and sent to Police Headquarters no fewer than 802 ambulance calls. Inquiry develops the fact that the service is often affected by contact with trolley wires, necessitating incessant vigilance and frequent repairs. Last September a live trolley wire and a dead telephone wire joined forces against the fire system, and before they were satisfied, the instru-



FIG. 4.—OPERATING ROOM, TELEGRAPH DEPARTMENT, NEW HEADQUARTERS OF BROOKLYN FIRE SERVICE.

is a well carved medallion of the arms of the city of Brooklyn.

The means of communication enjoyed by the department do not end here, for even should all the other circuits break down or give out, and transmitting or telegraphing apparatus fail at a critical moment, there is an independent telephone service, with neat board, Fig. 6, at which the operator sits all the time in direct touch with the various fire stations throughout the city. "Long distance" telephonic apparatus is used, on metallic circuits. There are 100 drops.

All this apparatus is for use, not for show. From data, kindly furnished by Mr. Watson, it appears that during its last year reported on, the Telegraph Bureau under his care had 406 miles of aerial wire on 2,299 poles, running

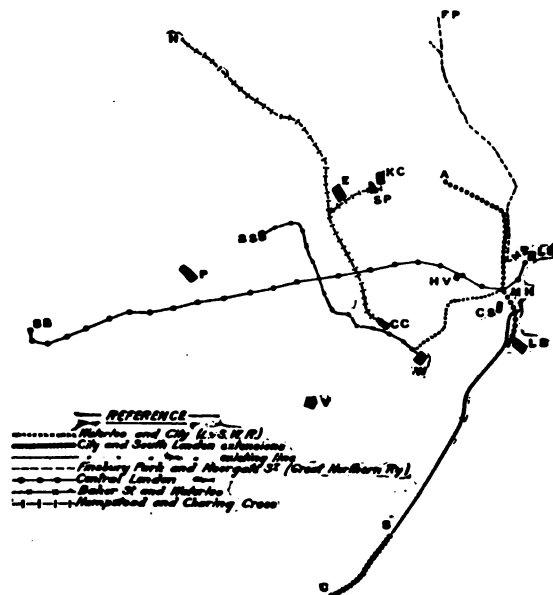
ments at two engines houses, a sub-office and truck station, and 10 alarm boxes, were burnt out. Steps are being taken all the time to improve the protection to the circuits, and it is hoped that before many years roll by all the fire wires will be in subways. It may be added that the office is in touch with 32 land engine houses, and 12 truck houses, as well as with the two fire boats, "Seth Low" and "David A. Boody."

Within the Headquarters Building, Mr. Watson and the other heads of departments are in direct communication with each other by means of a complete telephone system and an elaborate speaking tube service. The Brooklyn Fire Commissioner is Mr. F. W. Wurster, and the Deputy, Mr. C. A. Barrow. The operating staff under Mr. Watson at headquarters includes 12 well-trained employees.

ELECTRIC TRANSPORTATION DEPARTMENT.

LONDON UNDERGROUND ELECTRIC ROADS—PRESENT AND FUTURE.

THE prevalence of the rapid transit problem on this side of the Atlantic, and the apparent reluctance of even our largest cities to make use of an underground system of railways, although the streets are already choked with traffic and the elevated roads are having more than they do to cope with the constantly increasing crowds, has led the *Railroad Gazette* to make an interesting analysis of the London underground railways, both those already existing and the great new system now projected. Parliamentary powers, says our contemporary, have been obtained for a number of electric lines in the metropolitan area of London, of which the following six are the most important: 1. City & South London—Extension to Islington; 2. Central London—Shepherd's Bush to Liverpool street; 3. Waterloo & City; 4. Waterloo & Baker Street; 5. Great Northern & City—Finsbury Park to Moorgate street; 6. Hampstead & Charing Cross.

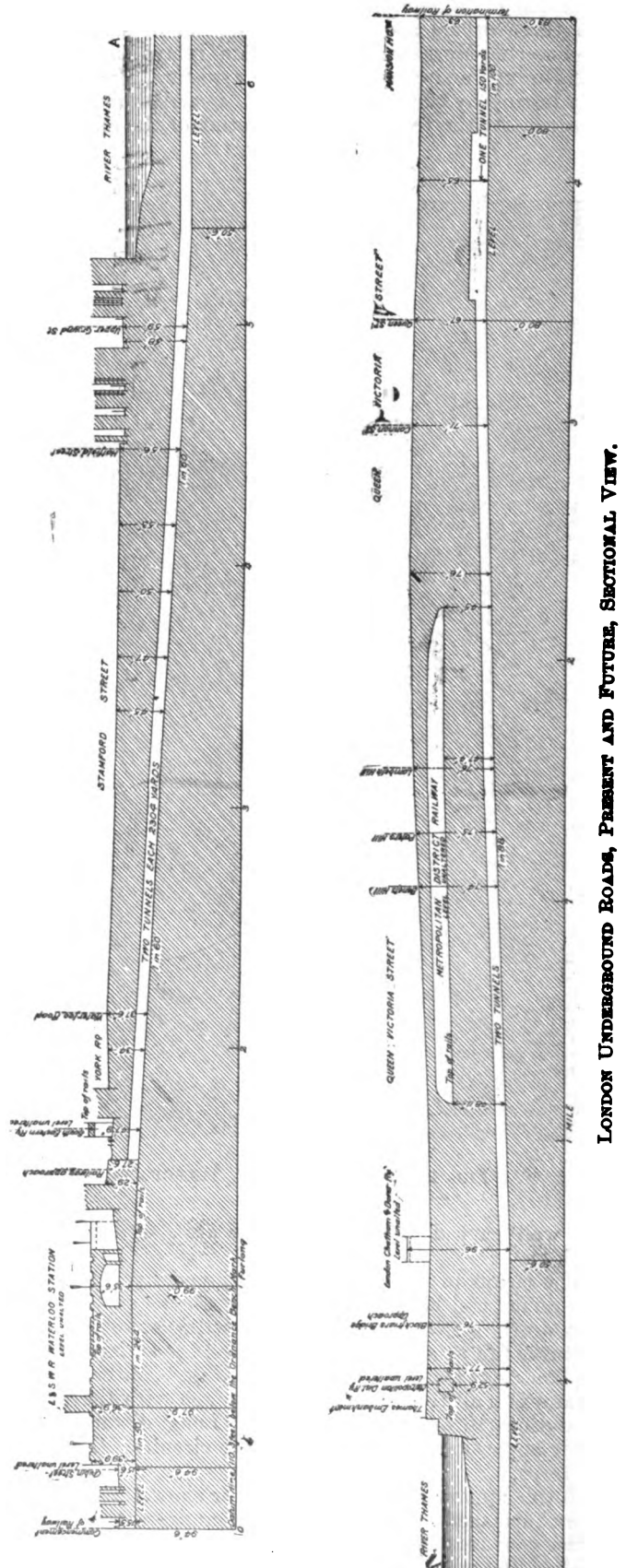


THE LONDON ELECTRIC UNDERGROUND LINES AND THE MAIN LINE TERMINI.

H = Hampstead.	KC = King's Cross: G. N. R.
FP = Finsbury Park.	BS = Baker St.: M. S. & L. (future).
A = "Angels" Islington.	P = Paddington: G. W. R.
MS = Moorgate St.	V = Victoria: L. B. & S. C. R. and
MH = Mansion House.	L. C. & D. R.
S = Stockwell.	W = Waterloo: L. & S. W. R.
O = Clapham.	LB = London Bridge: L. B. & S. C. R.
SB = Shepherd's Bush.	and S. E. R.
MAIN LINE TERMINI:	
E = Euston: L. & N. W. R.	OS = Cannon St.: S. E. R.
SP = St. Pancras: Mid. R.	OC = Charing Cross: S. E. R.
	HV = Holborn Viaduct: L. C. & D. R.
	LS = Liverpool St.: G. E. R.

All these are designed on the Greathead principle—i. e., cast-iron, built-up tunnels—a separate one for each line up and down, running as far as possible under the streets (so as to avoid compensation for damage to the foundations of private property, etc.), and at a depth below the surface varying from 40 to 70 feet, means of access being provided by lifts and staircases, or even inclined planes. Moreover, all these lines are authorized to use electricity as the sole motive power. Taking them *seriatim*, the present condition of these projects appears to be somewhat as follows:

1. *City & South London Extension*.—This line commences near the Borough High Street station, and runs parallel with the present one for a short distance, then turns off to the right and passes under the eastern end of the London Bridge terminus of the South Eastern and London, Brighton & South Coast railroads, making connection therewith by means of subways and elevators from the underground station. From this point the line strikes north, under the River Thames, on much easier grades and curves than the old one, which has grades of 1 in 80 against the load, on



heavy curves; and passing the present terminus in King William street, goes by the side of the Bank of England up Moorgate street and City road to the Angel tavern. No steps have, however, been taken by the railroad company to develop this extension in any way, as yet.

3. *The Central London* is in a somewhat similar condition, though it is perhaps a little further advanced. All necessary agreements have been made with the local authorities, plans are prepared and everything is in readiness for an immediate start when the financial details are in proper shape. At present a bill for extending the time in which the line must be completed is passing through Parliament, and this will allow another four years for carrying out the work.

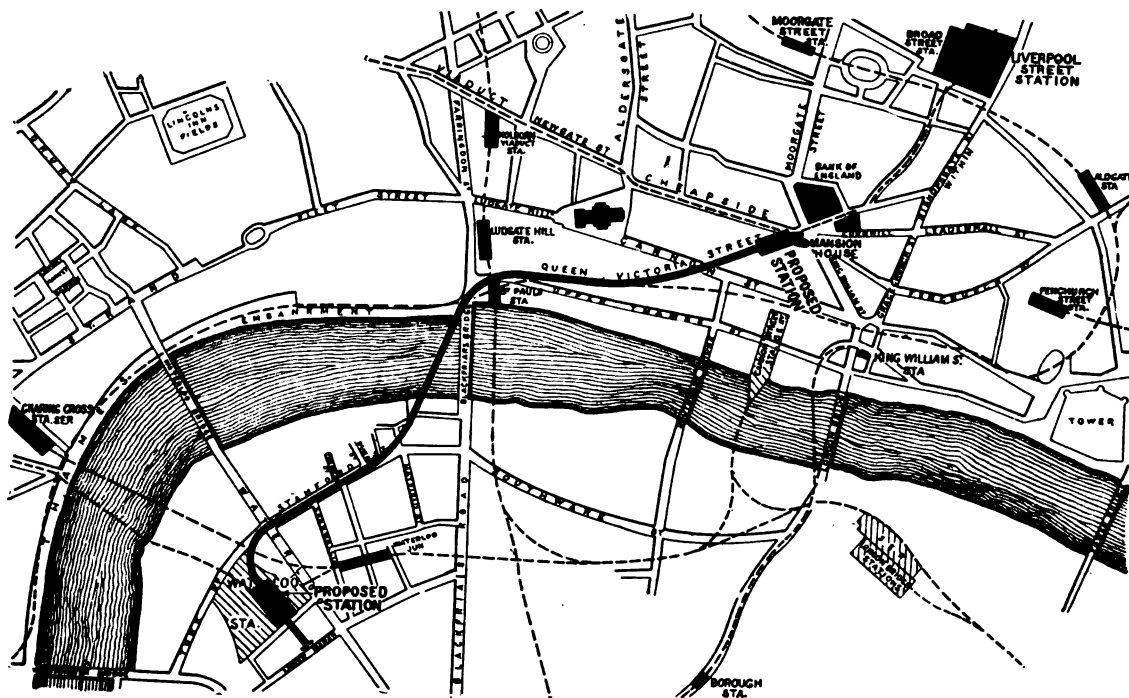
3. *The Waterloo & City Railway* alone of all those mentioned above is in active development. It will be entirely operated by the South Western Railway Co., and though, of course, a separate corporation in itself, yet the close connection with the trunk line is seen from the fact that of the eight Directors on the Board of the Waterloo & City line, four are Directors of the South Western line, whilst a fifth is the general manager, Mr. Scotter. The chairman and deputy chairman are the same in both companies, and the secretary of the one acts similarly for the other. The engineers to the new line are Messrs. Galbraith & Church, Victoria street, Westminster, and Mr. J. H. Greathead, who is perhaps *ex officio* attached thus to all the new lines.

According to the prospectus, interest at the rate of 8 per cent.

four minutes, as there are no intermediate stopping places. The gradients in both directions are such as help at starting and tend to brake the trains when approaching termini—that is, the line dips down under the Thames and rises again each side. The sharpest curves are just outside Waterloo, at one or two points before reaching the river, and at Blackfriars Bridge, where the line turns under Queen Victoria street, but none are of less radius than 380 feet. The maximum grade, as shown in the sections, is 1 in 60.

The tunnels—as with nearly all those now projected—will be 12 feet in diameter, with extra allowance at stations and at the curves. On the City and South London Line, which is only 10 feet, 6 inches in diameter, some trouble has been experienced. Not only is it necessary to keep the trains quite short (*i. e.*, three cars only), but the small size of the tunnel prevents the use of motor cars. The question of locomotives or motor cars has, however, not yet been decided, as regards the Waterloo and City Line, though the experience gained on the Liverpool electric line would tend to show the great advantage of the latter.

The tunnels are of the regular Greathead form. The electric generating station will probably be erected at the Waterloo end, where land is not so valuable as in the city, whilst fuel may be obtained more easily and with less expense. The only arrangement at present made, however, is for constructing the tunnels from a point just outside the Waterloo terminal premises to the end of the line in the City close by the Royal Exchange. With



LINE OF THE WATERLOO AND CITY ELECTRIC RAILWAY, LONDON.

per annum on the whole of the authorized capital, whether raised by issue or shares of debentures, shall be a first charge on the gross receipts of the undertaking before any deduction is made for working expenses. If the whole of the authorized capital—£720,000—be issued, the interest charge is £21,600 per annum, so that a traffic of only £500 a week will make the guarantee safe. The South Western Company is to work the line at cost price, such cost not in any case to exceed 55 per cent. of the gross receipts. After payment of the above-named 8 per cent. first charge and working expenses, the balance of receipts is divisible between the two companies, the Waterloo-City shareholders getting two-thirds and the South Western one-third. Seeing that the South Western is to control the line to all intents and purposes—build, finance and work it—it may rightfully be considered part of the South Western system; and, more likely than not, after its completion, when the earning capacity has been gauged, it may be formally taken over by the South Western.

Tenders have already been advertised for and received for constructing the tunnels. Seven responsible firms of contractors sent in estimates, the five lowest ranging from £229,064 to £353,170, and the contract has been awarded to Messrs. John Mowlem & Co., at the bottom figure. The additional cost of stations, electric generating plant and rolling stock will probably not exceed £150,000, so that apparently the authorized capital will not require fully calling up; still less will the borrowing powers need exercising.

The exact length of line authorized is 1 mile 4 furlongs 6.8 chains. The time occupied in transit will not exceed

regard to the City terminus, a point of some interest will shortly come up for decision by the directors as to the approaches to the line from the street surface. The Waterloo line at present is designed with exits (*i. e.*, surface stations, where the hydraulic elevators are placed) at two different points in Queen Victoria street; but it has been proposed that instead of having these independent approaches to the underground platforms, the Waterloo line shall make use of the large central station close at hand, which the Central London Railroad intends to erect, in conjunction with the city authorities, underneath the open space or street area in front of the Mansion House, to serve as an approach to its own line 70 or 80 feet below, and also to act as a convenient and safe street crossing, passageways being provided from the pavements or sidewalks across each street, so that foot passengers do not need to dodge carts, cabs, omnibuses and other vehicles.

4. Of the other lines enumerated, there is not much to be said. The *Waterloo & Baker Street Railway*, as the skeleton map will show, passes from a point adjacent to the Waterloo and City terminus under Waterloo station, thence under the river Thames and by way of Northumberland avenue, Pall Mall, Haymarket, Piccadilly Circus, Regent street and Portland Place into Regent's Park, curving round rather sharply into a terminus close to Baker street station on the Metropolitan Railway.

5. *The Great Northern & City Railroad* may be summed up also in three words, *in statu quo*. This line will have special interest when it is once taken in hand, as it is designed to some extent for ordinary rolling stock, the tunnels being 16 feet in diameter. There is actual connection at the Finsbury Park end with

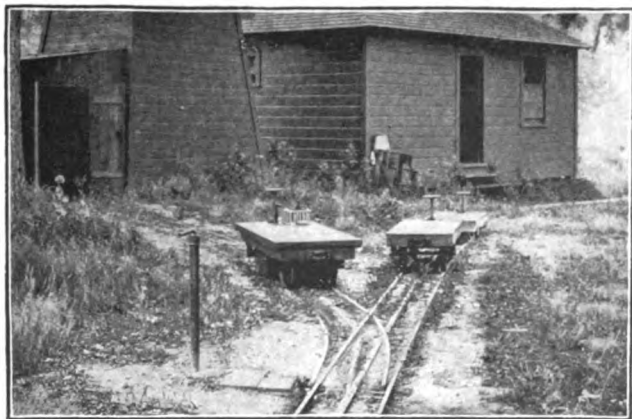
the Great Northern main line, and in this respect (i. e., the matter of a junction with surface lines) it stands alone out of all the new lines underground. Of course, the idea is to detach the steam locomotives and run the trains into and out of the city by means of electric locomotives.

6. The last of the lines enumerated, the *Hampstead & Charing Cross Railroad*, has had rather an unfortunate experience. It is undoubtedly designed to serve an excellent purpose, and fills a want that has long been felt by the London public, but apparently the present moment is an inauspicious time for asking the public to support anything financially. The prospectus of this line was recently issued, and capital was invited for its construction; but so poor a response was received that the directors did not go to allotment. In one respect this result was beneficial, for an excessive amount of capital was proposed, and the hand of the promoter was too visible. This would, perhaps, account for the investing public giving it a wide berth. The matter is now in better hands, and later on will come out in an improved form, when, perhaps, the money will be found. This line serves also to connect important points, and a small branch of it from Hampstead Road to St. Pancras is especially designed for the convenience of traffic from the big steam railroad termini at Euston, St. Pancras and King's Cross, down to Charing Cross.

In the skeleton map it will be seen how clearly the want of connection between many of these termini has led to the development of the underground lines. There is still much to be done, however, in the way of perfecting a network capable of giving the convenient and rapid cross connections which are really wanted for transfer of passenger traffic across the central parts of London.

THE SMALLEST ELECTRIC RAILWAY IN THE WORLD.—DELLWOOD, MINN.

On the banks of White Bear Lake, some fifteen miles from St. Paul, Minn., lies Dellwood, one of the numerous summer resorts of the Minnesota lakes. Between the railway station and one of

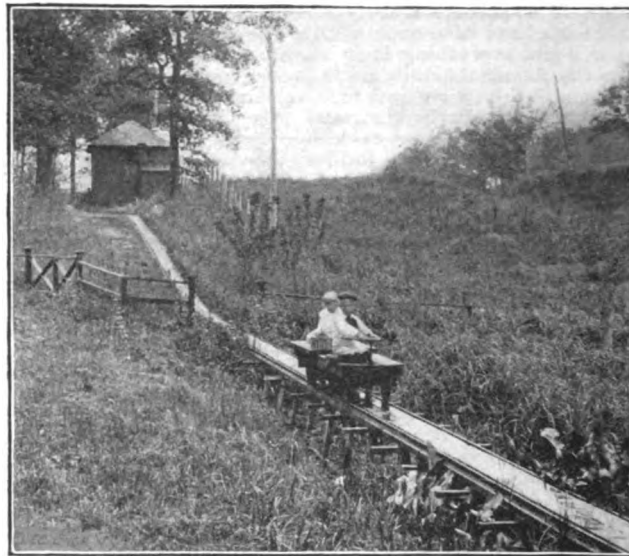


POWER HOUSE, CAR BARN AND SWITCH.

the beautiful summer homes, a distance of about 600 feet, is what is no doubt the smallest electric railway known, capable of actually transporting passengers and freight. The entire road was built and equipped by Mr. A. M. P. Cowley, a St. Paul banker, for the amusement and instruction of his son, Archie, a bright lad of seven years, who acts as motorman, conductor and brakeman with all the dignity and capability of a veteran in the service, not only giving his sisters and playmates frequent "excursions" but also doing an extensive passenger, freight and express business between the two termini. The length of the road is a trifle over a tenth of a mile and the equipment consists of a motor car and two trailers, each car being five feet long by two feet wide. The gauge of the road is 14 inches, the rail being regular steel T rail, weighing 24 pounds per yard. The rails are laid on 2 x 4 inch pine ties and bonded with No. 14 copper wire. Instead of the overhead trolley, the third rail system is used, the third "rail" consisting of a flat iron strip $\frac{1}{8} \times 1$ inch nailed on a wooden strip between the two rails.

The power house situated at the end of the line is a neat frame structure, containing the engine, generator and switchboard, as well as a fully equipped machine shop. The engine is a 2 H. P. Shipman petroleum engine and is belted to a 2 H. P. Perret compound wound generator, which when driven at a speed of 1,600 revolutions, gives a current of 15 amperes at a pressure of 110 volts. The engine runs at a speed of 375 revolutions per minute and, being entirely automatic, it, as well as the generator, requires scarcely any attention or care. On one side of the engine room is the switchboard, containing all necessary appliances for

the regulating, measuring and indicating of the current, such as rheostats, Weston volt and ampere meters, branch and main line switches, safety fuses and lightning arrester. From the switchboard the current is led by underground conductors to the rails

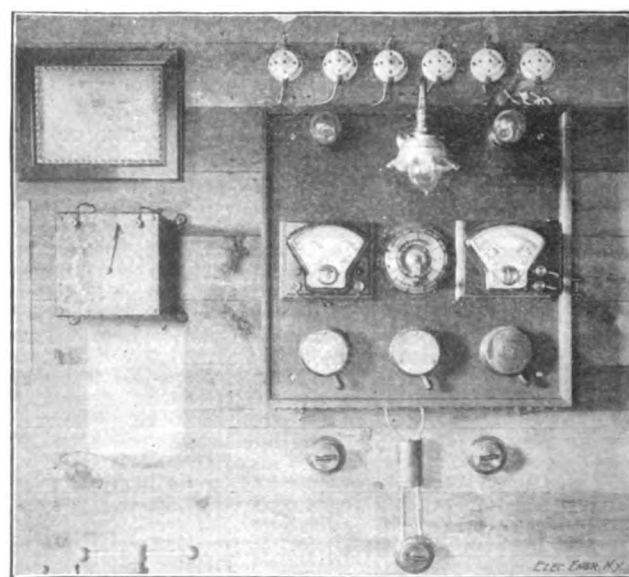


TRACK AND CARS.

and contact strip, and also to the owner's residence which is lighted throughout by incandescent lights. Adjoining the power house is the car barn in which the cars are housed during the winter and at night.

The motor car is equipped with a one horse power motor, transmitting power by double reduction gears to the car. The gears are cut from the solid and run practically noiselessly. A starting rheostat is conveniently placed at one end of the car, as well as a reversing switch and safety fuse.

The road is practically straight, but has two rather steep grades of about 10 and 16 per cent. respectively. The motor car will haul the two trailers, each loaded with two adults and a child, up the steepest grade with ease. With the motor car and one trailer starting from the power house, the trip to the end of the line is made in 20 seconds. Our illustrations give some excellent views of this novel and interesting railway, and one of them shows the entire operating staff in action. The road suffered no inconveni-



POWER HOUSE SWITCHBOARD.

ence during the recent strike, and its dividends are as large and as regular as ever. This the general manager attributes to the fact that his employees are not union men, and that earnest efforts are always made to maintain friendly relations even in times of trouble.

FRANCHISE PAYMENTS BY NEW YORK STREET RAILWAYS.

COMPTROLLER FITCH has prepared a statement showing the arrangement under which revenue is paid to the city by the street railway companies. No uniform rule governs payments. Some of the companies pay stipulated amounts for privileges; others are subject to car license fees, while recently incorporated companies pay for franchises according to the provisions of the general railroad law. Payments are regulated as follows:

Broadway and Seventh Avenue and Broadway Surface Railroad.—From 1885 to 1890 this company paid the city 8 per cent. of its gross receipts and \$50 per annum license fee for each car; from 1890 to 1893, 5 per cent. of gross receipts, \$50 per car, and \$40,000 per annum stipulated sum; from 1893, 5 per cent. of gross receipts, not to be less than \$150,000 per annum, and \$50 per car.

The Sixth Avenue Railroad Company.—Fifty dollars per car per annum since 1889.

Chambers and Grand Street Ferry Railroad.—Three per cent. from 1887 to 1891, and 5 per cent., with \$50 horse-car fee, since 1891.

Central Cross-Town Railway Company.—Three per cent. of its gross receipts from 1887 to 1893.

Central Park, North and East River Railroad Company.—Fifty dollars per car per annum since 1886.

Ninth Avenue Railroad Company.—Fifty dollars for each car since 1889.

Second Avenue Railroad.—Five per cent. of gross receipts from 1890, and one-third of 1 per cent. on certain extensions.

Third Avenue Railroad.—Twenty dollars fee for each horse-car from 1886 to 1893.

Twenty-third Street Railroad.—Five per cent. of gross receipts from 1890.

Twenty-third Street Railway.—One per cent. of gross receipts from 1891, and \$50 for large cars, and \$25 for small cars.

North and East River Railroad Company.—Sold at auction for 88 per cent. gross receipts; unable to pay same; now operated by contractor.

Hudson River Railroad Company.—Dummies, \$50 per year each.

New York Elevated Railroad.—Five per cent. net proceeds; paid nothing since 1890; suit brought by city has recently been decided by Court of Appeals, holding that city can recover 5 per cent. of net income only on passenger traffic on Ninth avenue line from Greenwich to Sixty-first street, and $2\frac{1}{2}$ per cent. from Sixty-first to Eighty-third street.

Christopher and Tenth Street Railroad.—Three per cent. of gross receipts since 1888.

Dry Dock, East Broadway and Battery Railroad.—Five per cent. net proceeds; \$50 each for large car, \$25 for small car, since 1888.

Eighth Avenue Railroad.—Fifty dollars per car per year since 1882.

Forty-second Street and Grand Street Ferry Railroad.—Fifty dollars per car since 1888.

Forty-second Street and Manhattanville and St. Nicholas Avenue Railroad.—Three per cent. of gross receipts from 1885 to 1891, and 5 per cent. from 1891.

Houston, West Street and Pavonia Ferry Railroad.—One thousand dollars per annum stipulated sum, and \$50 for each car. New York and Harlem Railroad.—Three per cent. of gross receipts of extensions from 1885 to 1893.

Twenty-eighth and Twenty-ninth Street Railroad Company.—Not completed; to pay 8 per cent. of gross receipts first five years, and 5 per cent. thereafter, to which add $29\frac{1}{10}$ per cent. bid at time of sale.

Metropolitan Crosstown Line.—Six per cent. of gross receipts and \$50 per car from 1891.

Union Railway Company.—One per cent. of gross receipts when the average reaches \$1,700 per day; has paid nothing in two years.

The statement does not show exact revenues for any given period.

ELECTRIC RAILWAY ADVANCE IN TORONTO.

Toronto is succeeding very well with its plan of watering the principal streets by the aid of the trolley. King street, Yonge street and other leading streets on which the electric cars run are watered from a tank run by electricity along the car lines. The tank is an ordinary iron arrangement cased in wood, neatly painted, mounted on a truck with a trolley pole on top, all the tanks being built by the Toronto Electric Railway Company in its own shops. It runs along the street at the same rate of speed as the street cars, and moving so rapidly the water has not had time to dry on one end of the street before the tank has reached the other end. By this simple but ingenious system the corporation saves a large annual outlay and there is a remarkable absence of dust.

The Toronto Company is also trying some large cars. One that it turned out last week is no less than 42 feet over all. It runs very nicely, and is equipped with Canadian General Electric motors. President Mackenzie and his American associate, Dr. Everett, are working to make the service the finest on the continent,

in every respect. Their system is now carrying 80,000 to 100,000 people daily.

The Toronto road was critically inspected by many of the delegates to the late Intercolonial Conference, who were surprised to find that in electric railroading, as exemplified at Toronto, Ottawa, Montreal and other cities, Canada was much farther ahead than any of the other British Colonies. It is predicted that at least one indirect result of the conference will be the extension of electric railways in Australia, New Zealand and South Africa.

A LONG OHIO ROAD.

Columbus and Cleveland capitalists have decided to construct an electric railway from Columbus to Buckeye Lake Park, formerly the Licking reservoir, and to erect a hotel, boat-houses, etc. The line will be about thirty miles long, and will run along the old National road to Hebron and thence to the lake.

THE NEW YORK-PHILADELPHIA ELECTRIC RAILWAY CHARTERED.

THE certificate of incorporation of the New York and Philadelphia Traction Company, capitalized at ten millions, was filed with Secretary of State Kelsey, of New Jersey, on July 20. With the certificate were filed copies of the maps, surveys, routes and descriptions of what may be the greatest electric railway system in the United States. In addition to the customary fees a deposit of \$25,000 was made.

MISCELLANEOUS.

THE ELECTRIC LIGHTING OF RAILWAY TRAINS.¹—II.

(Concluded.)

BY M. B. LEONARD.

In the paper that the writer had the pleasure of presenting at the Niagara Falls Meeting of the Association of Railway Telegraph Superintendents, in 1890, he concluded as follows:

"The electric lighting of trains has been hitherto considered very much as a luxury, but its superiority has been demonstrated in so many ways that it is now regarded almost as a necessity. Before it can be generally adopted, it must be practicable to light the cars on a large scale, and to maintain the plant on each train in good order without expert assistance; it must also be so simple and at the same time so durable that mechanics of ordinary ability can be utilized to make the few repairs it will require; its cost, therefore, must be reasonable as compared with other methods of lighting and the character of the trains on which it is to be used. From the facts brought forward in this paper it will be conceded that all of these requirements are filled by the English system of taking power from the car axle. It is therefore confidently expected that the well-known ingenuity of our American engineers and inventors will be found sufficient to overcome the obstacles that now prevent us from utilizing, in the same way, the motion of the trains on our roads."

That this confidence has been realized to the fullest extent is, I believe, demonstrated in the system recently brought out by Lieutenant I. N. Lewis, of the U. S. Army, and covered very fully by the patents recently issued to him. In this system are combined, a dynamo fixed on the car truck itself and belted to the car axle, with flexible connection charging a storage battery of 12 cells carried under the car, and at the same time, if necessary, supplying current for the lamps in the car. The results of the trials that have been in progress for the past four months on the business car of General Manager Stevens, of the C. & O. Ry. indicate that the problem of cheap electric lighting for passenger trains has been fully and satisfactorily solved by this method of operation.

In the Lewis system, a bipolar dynamo wound for a maximum output of 25 volts and 50 amperes, with one set of carbon brushes in rectangular holders fixed at right angles to the commutator, and always in contact with it, using graphite bearings for the armature shaft to do away with the need of oil, and iron clad or fitted with a close iron cover, protecting commutator, fields and brushes, is bolted on to the bolster or truck beam, and connected by a raw hide belt 8" wide to a 20 inch pulley on the axle, the armature shaft carrying a 7½ inch pulley. To keep the belt tight on the armature pulley because of the short distance between centres a pair of spring idlers is used, consisting of two flanged pulleys 4½ inches in diameter, over which the belt runs, revolving on graphite bearings and held together by a spiral spring on each side with adjustable nuts.

The distinguishing feature of this system is the way in which the dynamo is wound, by which the machine is made self-regulat-

1. A paper read at the Annual Meeting of the Association of Railway Telegraph Superintendents, Detroit, Michigan, June 14, 1894.

ing for all speeds and a constant potential at the battery terminals obtained without employing any of the auxiliary regulating devices heretofore necessary in plants of the English type in order to obtain constant E. M. F. regardless of the varying speed of the train. This Lieut. Lewis has accomplished by utilizing the compound principle in the winding of the field coils. One of the coils is energized with current from the storage battery, the circuit being open, until closed by a ball governor switch on one end of the armature shaft rotating vertically and operating to close the circuit at a predetermined speed, thus preventing waste of current when the car is standing still. While the compound, or series coil of the fields, instead of being wound in the usual way to maintain the strength of the field magnetism, is reversed or wound differentially, so that, instead of augmenting the field magnetism as the speed of the car rises, thus raising the voltage, it acts precisely in the opposite manner, and demagnetizes or weakens the field as the car speed increases, keeping the voltage down, notwithstanding the increased speed, so that the potential does not exceed the maximum of 25 volts, while the current output may rise from 1 to 50 amperes, depending on the speed of the car. On the dynamo is a slate block to which all of the dynamo wire terminals are run, and to which is also fitted a movable slate cap with contact points, terminating in a flexible cable of wires for the purpose of carrying the current generated by the dynamo, &c., to the storage batteries, lamps, automatic pole

illustrates the several features above described. The battery will furnish about eight hours, lighting when the car is stationary.

A brief description of the method by which current of the same polarity is always delivered to the battery, regardless of the reversals of direction in which the car is moving, will doubtless be of interest. Imagine two V-shaped strips of brass placed opposite but not in contact with each other, their points extending outward, with another strip of brass above and one below the opening so formed; to these latter strips the charging wires from the armature are respectively connected; to the former or V-shaped strips are respectively attached the positive and negative wires of the battery. Pivoted in the centre of the diamond shape thus formed is a vertical lever fitted with contact brushes that will engage the top strip and right hand side strips and at the same time the lower strip and the opposite side strip; actuating the vertical lever is an electromagnet firmly secured thereto, and connected by flexible wires to the armature leads, this electromagnet is so arranged as to play between two other electromagnets, the polarities of which are so adjusted that their poles presented to the poles of the vertical lever electro magnet, will be of the same sign, thereby causing repulsion on one side and attraction on the other side of the lever magnet, thus connecting the right hand strip and the left hand strip with the bottom strip, or vice versa.

Assuming that the positive current is flowing from the arma-

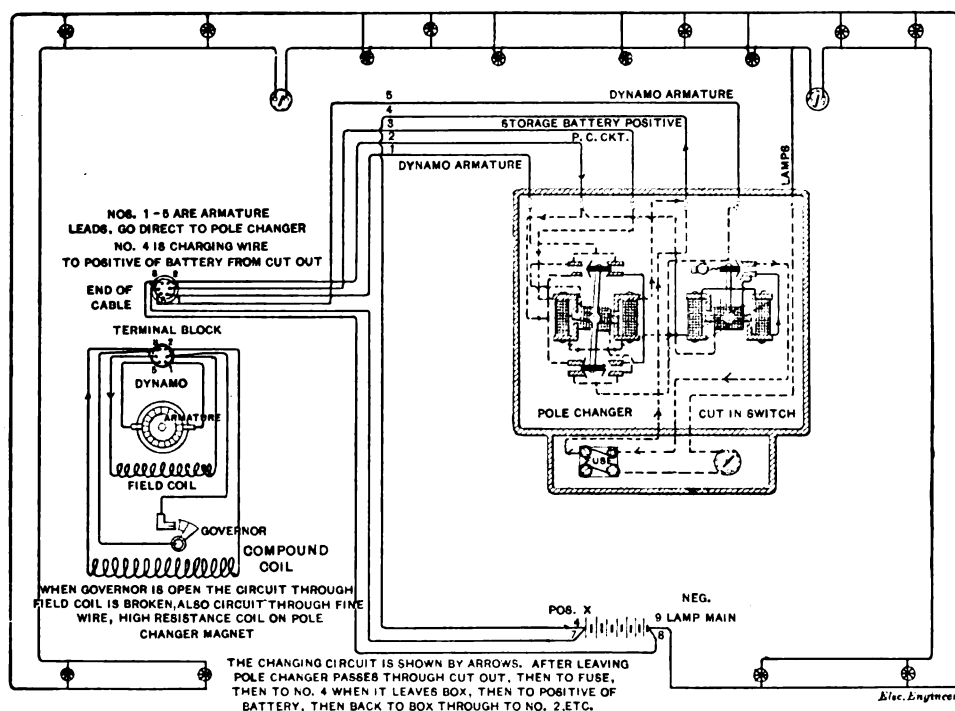
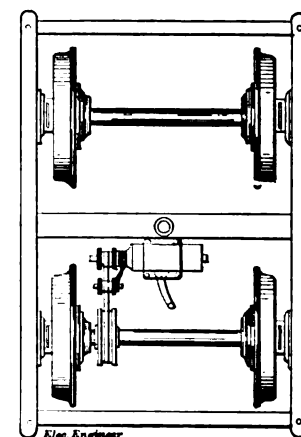
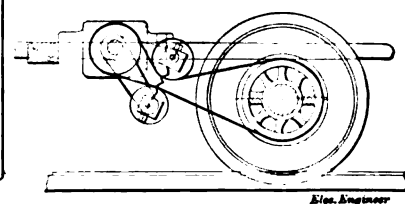


DIAGRAM OF THE LEWIS SYSTEM OF CAR LIGHTING.



PLAN VIEW OF CAR TRUCK.



SIDE ELEVATION OF OPERATING MECHANISM.

changer and cut out switch on the car, so that in the event of the car truck having to be moved from the car for any purpose, it is only necessary to turn a single screw to disconnect the movable cap and dynamo terminal block, in order to take out the truck without interfering with the electrical apparatus.

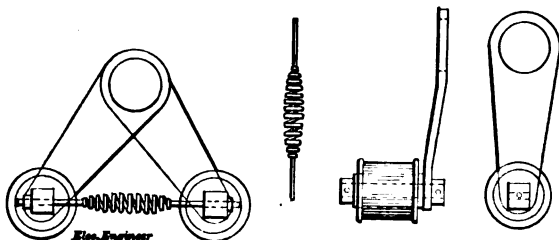
Next to the dynamo, the most important features of this system are the pole changer, that automatically insures a current of constant polarity passing into the storage battery or lamps, regardless of the direction in which the car is moving, and the cut out switch that opens automatically the charging circuit between the dynamo and storage battery when the speed of the car falls below a certain limit, and thereby prevents the battery from discharging itself through the dynamo. Another function of this apparatus is to close automatically the charging circuit as soon as the speed of the car is high enough to generate the proper E. M. F. for charging. These two devices are placed side by side in a slate backed box $2\frac{1}{2}$ inches deep, 12 inches long by 10 inches wide with a glass front permanently fastened, and after being once adjusted no further attention is necessary. This box, to which is connected the flexible cable from the dynamo above referred to, is the only portion of the apparatus placed inside the car, and can be put up in the toilet room, linen closet or other convenient location. To the bottom of it is attached a porcelain fuse block, and a snap switch by which all the lamps in the car can be turned on or off simultaneously if desired. A neat lid and lock prevents tampering by the curious minded. The accompanying diagram, which shows the wiring of General Manager Stevens' car,

ture to the top strip, a contact of this strip with the right hand strip will send the positive current into the battery, from which it returns through the left hand strip, and the bottom strip to the negative lead of the armature. Reversing the motion of the car, what happens? The top strip, previously the positive lead, now becomes the negative, and the bottom strip is now the positive lead. As the armature revolves in the opposite direction the lever is thrown over, engaging the top strip with the left hand strip, and the bottom strip with the right hand strip, the positive current flows through the right hand strip just as before, to the battery and back to the left hand strip, thence to the negative lead of the armature. Thus whether the car moves backward or forward the right hand strip always conveys the positive current to the batteries and the left hand strip is the medium by which the circuit is established with the armature. Thus, the battery is always charged with the same polarity by this beautiful and simple device, which is unailing in its operation.

The cut-out switch may be illustrated by a short vertical lever pivoted in the centre, carrying spring contact points at one end and that on operating the lever close the charging circuit of the batteries which is normally open. On the other end of the lever is fixed a small electromagnet, its terminals in circuit between the armature leads. Opposite this end of the lever a large electromagnet is permanently fixed and connected in series with the charging circuit. As the dynamo builds up or increases its output, the core of the lever magnet will be strongly polarized, and as the core of the fixed magnet is of the opposite polarity, the

attraction between the two cores becomes so strong as eventually to pull over the lever, and close, by means of the spring contact points upon it, the charging circuit of the batteries, the lever being held firmly in this position. The point at which this is done is determined by a suitable retractile spring with lock nuts. Should the current be reversed in the large magnet, through the fall of voltage in the dynamo by the car slowing down, and the consequent discharge of the battery back through the switch, then there will be an actual repulsion between the cores of the two magnets, and the switch will be forcibly thrown back, opening the charging circuit and thus automatically preventing the discharge of the storage battery through the dynamo.

The storage batteries used in this system may be of any type though the results obtained thus far with the chloride accumulator appear to be the most satisfactory. The batteries are carried



DETAILS OF THE SPRING IDLER.

in a box under the car and out of the way, the sides of the box being pierced with holes to allow the gas evolved during the charging to be dissipated freely. In the event of four or more cars equipped with this system being carried in a train, they are fitted with a special form of switch to open the charging circuit automatically whenever the battery is fully charged and thus prevent the unnecessary taxing of the locomotive for power. As the apparatus does not operate until the train has attained a speed of about 20 miles per hour, no extra effort is imposed on the locomotive in starting the train.

The cost of the entire outfit, including dynamo, batteries, switches, running gear, lamps and wiring, does not exceed \$500 per car, and each car is entirely self-contained, though if necessary, batteries on neighboring cars could be charged when desired. The apparatus being entirely automatic in its operation requires no skilled attention save a periodical inspection at terminal points, and while the tests on the C. & O. Railway developed some mechanical defects that were remedied as fast as they appeared, it is gratifying to state that not once has the electrical portion of the apparatus failed to work properly. Arrangements have been made to equip some of the Pullman cars on the C. & O. Railway that do not run into Covington, Ky., and therefore cannot be supplied by our regular charging plant. For some time past a car equipped with this system has been running regularly on the Brooklyn Bridge at New York with perfect success, and another car is about to be installed there.

A very conservative estimate has been made by eminent electrical engineers of the cost of lighting a car by this system on the basis of 10 hours per day of lighting, and is stated to be as follows:

For equipment of one ordinary passenger coach fitted with 12 lamps of 16 c. p. 24 volts, 1 kilowatt dynamo, 12 cells storage battery, 150 ampere hours capacity each:

Original cost of apparatus.....	\$500 00
Cost of operation per annum:	
Interest on original cost at 6 per cent.....	\$30.00
Depreciation of battery at 25 per cent. on 12 cells at \$12.50 each...	40 63
" " on balance of plant at 10 per cent.....	83.75
Lamp renewals (500 hour basis).....	40.00
Attendance.....	10 00
Pulleys and belts.....	6.60
Other renewals:	
Brushes.....	\$1.50
Jars.....	3.00
Acid.....	2.50
Connections.....	1.70
Switch.....	3.00
Shade and sockets.....	2.50
	14.20

Total per car per year..... \$175.17

With the graphite bearings no oil is used. The batteries being stationary, no cranes are required and the depreciation is very much reduced.

Total estimated cost per car per month.....	\$14.5975
" " " " " day.....	.4799
" " " " " hour.....	.0479
" " " " " lamp hour.....	.39

The significance of these figures, which are believed to be above rather than below the actual cost of operation, and the economy of lighting by this system, will be more fully appreciated when it is borne in mind that the cost of generating the current alone in the largest and most modern of our central electric light and power stations, equipped with the best compound condensing engines, etc., is estimated by the best authorities to be about $\frac{1}{4}$ cent. per lamp hour, which does not, of course, include the cost of lamp and other renewals or depreciation of the plant outside of the central station.

It is stated that on the London, Brighton & South Coast Road, the Telegraph Superintendent of which, by the way, is one of the inventors of that system, there were but two failures of the dynamo-axle system in four years; that the apparatus can be used for several weeks at a time with no attention beyond lubrication, and at the end of this time only a readjustment of the commutator brushes is necessary, which puts the machine in condition for a like longer period. There seems to be no reason to believe that the Lewis system will not show as good a record as this, if not surpass it, as no oil is required for lubrication, and no adjustment of the carbon brushes is necessary, though experiments are still being carried on to determine the most efficient and durable form of axle connection. It is expected that this feature will be decided upon within the next 90 days.

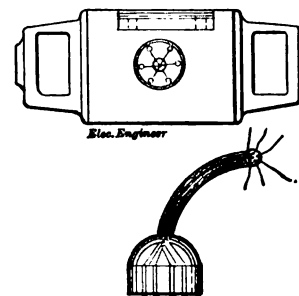
Comparing the various systems of car lighting above described and reducing the figures to a uniform basis of ten hours per day of lighting, we have the following results:

System.	Avg. cost per car.	Avg. lamp per car 16c.p.	Total illumination per car.	Cost per car day.	Cost per car hour in cts.	Cost per lamp hour in cts.
Comb. Dynamo and Storage Battery.....	\$908.00	22 $\frac{1}{2}$	360 c. p.	\$1.99	19 $\frac{1}{2}$	$\frac{1}{2}$
{ Silvey Battery (C. & O.) Storage Battery (Pullman Co.).....	709.00	9 $\frac{1}{2}$	148 $\frac{1}{2}$	.944	9 $\frac{1}{2}$	$\frac{1}{2}$
{ Direct Current (C. M. & St. P.).....	650.00	27	432	1.694	16 $\frac{1}{2}$	$\frac{1}{2}$
Lewis operated from car axle.....	323.00	18	288	0.977	9 $\frac{1}{2}$	$\frac{1}{2}$
Pintsch Gas.....	500.00	12	192	0.479	4 $\frac{1}{2}$	$\frac{1}{2}$
Oil.....	400.00		148 $\frac{1}{2}$	0.948	9 $\frac{1}{2}$	$\frac{1}{2}$
	72.07		148 $\frac{1}{2}$	0.686	6 $\frac{1}{2}$	$\frac{1}{2}$

(The average cost per car of the Pintsch gas system does not include proportion of cost of generating and compressing apparatus. Six berth lamps per car are included in the figures for the C. M. & St. P. system, though not always in use.)

These figures appear to be substantiated by the statement contained in a recent issue of *Science*, of London, to which my attention was directed after the above figures were made up. That paper gives the cost of equipment per train of 10 cars for the London, Brighton & South Coast Railway, about as follows: For gas, \$3,500; electric light, \$2,000; oil, \$600; and the cost of maintenance per annum for gas, \$600; oil, from \$350 to \$650 per train, and for electricity, figuring on an average of 80 trains operated by the car-axle system, \$250 per train per annum.

It is evident from the data above set forth that the lighting of our passenger cars by electricity has passed far beyond the experimental stage, and can now be accomplished at an expense no greater than that of oil, in fact even less. It is, therefore, greatly to be hoped that the superior advantages of electricity will, ere long, cause it to be utilized so largely that not only will our trains be illuminated by this, perhaps the most useful of all Nature's



TERMINAL BLOCK ON DYNAMO AND CAP WITH CABLE.

forces, but that the weary traveller may in winter be warmed by heaters, and in summer cooled by fans operated from electricity generated by the least expensive of all methods, the movement of the car itself.

[NOTE.—Mr. Gibbs, of the C. M. & St. P. Railway, under date of June 27, 1894, informs the writer that for comparison on a ten-hour basis there should be deducted the wages of one man, as two trains could be run with three instead of four men. With this deduction the cost per car per hour would be about 8c., and cost per lamp per hour about .44c. An examination of the schedule of these trains, however, would indicate that the propriety of this deduction may be questioned. Mr. Bauer, of the Pullman Company, under same date, referring to the Pullman systems of equipment, etc., remarks: "Your figures reduced to a uniform basis of ten hours per day lighting, are as near correct as it is possible to get."—M. B. L.]

THE ELECTRICAL ENGINEER.

(INCORPORATED)

PUBLISHED EVERY WEDNESDAY AT

303 Broadway, New York.

Telephone: 3360 Cortlandt.

Cable Address: LENGINEER.

Geo. M. Phelps, President.

F. B. COLVIN, Treas. and Business Manager.

Edited by

T. COMMERFORD MARTIN and JOSEPH WITELER.

Associate Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—630 Atlantic Avenue, Boston, Mass.

Western Editor and Manager O. KAMMEYER, 1430 Monadnock Building, Chicago, Ill.

New York Representative, 303 Broadway, }
Philadelphia Representative, 1018 Chestnut Street, } W. F. HANKE.**TERMS OF SUBSCRIPTION, POSTAGE PREPAID.**

United States and Canada, - - - - - per annum, \$3.00
 Four or more Copies, in Clubs (each) - - - - - 2.50
 Great Britain and other Foreign Countries within the Postal Union " - - - - - 5.00
 Single Copies, - - - - - .10
 [Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1893.]

EDITORIAL ANNOUNCEMENTS.

Addresses.—Business letters should be addressed, and drafts, checks and post-offices orders made payable to the order of THE ELECTRICAL ENGINEER. Communications for the attention of the editors should be addressed, EDITOR OF THE ELECTRICAL ENGINEER, 303 Broadway, New York City.

Communications suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.

Advertisements.—We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers.

VOL. XVIII. NEW YORK, AUGUST 1, 1894. No. 336.

CONTENTS.

EDITORIAL :—	PAGE.
City Garbage and Sewerage	90
And There Shall Be No More Sea.....	91
Underground Electric Railroads.....	91
ARTICLES :—	
The Brooklyn, N. Y., New Fire Department Headquarters (Illustr.).....	81
Electricity as a Fire Hazard.—V.	94
The World's Fair in Miniature.....	95
TRANSPORTATION DEPARTMENT :—	
London Underground Electric Roads (Illustr.).....	84
The Smallest Electric Railway in the World: Dellwood, Minn. (Illustr.)....	85
Electric Railway Advance in Toronto.—The New York-Philadelphia Electric Railway Chartered.—A Long Ohio Road.....	87
MISCELLANEOUS :—	
The Electric Lighting of Railway Trains.—II. (concluded.) (Illustr.).....	87
Incandescent Lamps; Their Use and Abuse. (Illustr.).....	92
LEGAL NOTES :—	
Street Car Stock Liable to Taxation.....	96
Anglo-American Telegraph Company (Limited) vs. Compagnie Française du Télégraphe de Paris a New York.....	96
Edison Electric Light Co. vs. Star Electric Lamp Co.....	96
The Standard Paint Co. vs. Henry J. Bird and James L. Reynolds.....	96
Electric Light and Meter Inspection in Canada.....	96
LITERATURE :—	
Coerper's "Die Wechselstrom-Transformator-Anlagen zu Köln und Amsterdam"	97
INVENTORS' RECORD :—	
Classified Digest of U. S. Electrical Patents Issued July 17 and 24, 1894.....	97
REPORTS OF COMPANIES :—	
Fort Wayne Receivership	98
TRADE NOTES AND NOVELTIES AND MECHANICAL DEPARTMENT :—	
The Manchester Type Slow Speed Motor. (Illustr.)—Robinson Machine Co.—Electrical Porcelain Goods.—Sebastian Lathe Co.—Success of the Garlock Packing Co.....	99
General Electric Railway Generator Switchboard Panel. (Illustr.)—Philadelphia Notes.—New York Notes.—Western Notes.....	100

CITY GARBAGE AND SEWERAGE.

THE problem of the disposal of city garbage, and of the purification of city sewerage, becomes daily one of greater importance, and occupies the public mind in all civilized countries more than it has ever done before. Indeed, it might be said that this problem is of equal magnitude with that which concerns pure food and untainted water. Perhaps we are more sensitive about these matters than our forefathers were, though the remotest ancients gave many evidences of appreciating the benefits of cleanliness. Perhaps this anxiety is in some degree due to the flood of light thrown of late years upon the germ origin of diseases of all kinds. Perhaps the general luxury of modern times brings with it a more facile spread of infection and contagion, and also a greater difficulty in disposing of a larger amount of debris and refuse. Be all this as it may, it is the unquestioned fact that the public is more than ever aroused to the dangers of filth, and that public sentiment is nearing the day when to live in dirt will be regarded as a more than sufficient *casus belli* against any nation.

At the present time New York is becoming thoroughly alive to the necessity of finding more scientific and satisfactory ways alike of purifying its water, disposing of its garbage, and disinfecting its sewerage; and it may be hoped and believed that its feelings on the subject are shared by other cities all over the country, for there is not one of them that is clean enough. New York has had peculiar conditions, however, and has not hitherto met them very successfully. Its garbage has daily greeted the eyes of the approaching visitor from Europe and has befouled the beaches for miles around. Its sewers still do violence to the ordinary nose, and but recently has any vigorous attempt been made to rescue the "quick freshes" of its drinking water from rural contaminations. In most respects, New York is no worse than other great cities; but it ought to be better.

Mayor Gilroy has just selected a commission to consider the problem of garbage disposal, and his letter of appointment shows a full sense of the importance of the questions involved. As the Mayor says: "The disposition of the street cleaning refuse, the ashes, and the garbage of so great a city, presents one of the most difficult problems of city government;" and most of us will agree with him that the present system is uncertain, expensive and inadequate. That system, briefly described, consists in the collection of the garbage at about a score of dumps on the water front of the city and then either towing it out to deep sea in big scow-loads, or else depositing it at some marshy spot where it is desirable to make or reclaim ground. So far, the garbage has been indignantly rejected by the sea—should it get there; and when rapidly massed at such places as Riker's Island it has become so great a nuisance that only a heroic, wholesale treatment with the modern process of electro-disinfection has been able to reduce it to anything like "innocuous desuetude." And this brings us to the point, that in this respect of garbage disposal, as in so many other modern city problems, electricity is confidently expected to serve as the magic wand that will charm every ill and make all things new, sweet and pleasant. If the garbage is cremated, it is supposed that its heat energy

will be converted into brilliant electric illumination. If it is to be dumped wholesale in some remote spot, electricity, after its recent extraordinary display of purifying power at Riker's Island, is to transform the villainous refuse into beautiful market gardens and choice villa lots. The violets that were to spring from Ophelia's fair and unpolluted corse could not compare for an instant with the flowers and residences that are to adorn the once stinking, fermenting mountains of New York's garbage!

It is early, of course, to forecast the report of a committee that has not yet got down to work, but, as we have already intimated, electricity will certainly be found in it as a prime factor for all future work. What can be done in connection with "destructors," we have already described in these pages more than once; while, if Dr. Metz, chemist of the New Orleans and Louisiana Health Boards, is to be credited, the use of electrozone at Riker's Island has been attended with results nothing short of marvelous. With one means or the other, probably with a combination of them in adjustment to the circumstances, New York may soon find its way to higher sanitary and hygienic conditions, and become more than ever a delightful place to live in.

That New York is not alone in these difficulties may be learned from the casual reading of almost any American or European newspaper. Thus the *Evening Post* of July 27, quoting from the *Pittsburgh Dispatch*, speaks of Allegheny City as at the head of the list of the percentages of deaths from typhoid fever, Pittsburgh coming fourth, the disease being epidemic in the two cities the year around. And then we read as follows:—

"A well-known Pittsburgh physician who was asked if there was any connection between the Pittsburgh drinking water and typhoid fever, led the inquirer out to the back of his house. "Do you hear it?" the physician asked. "Hear what?" "Why, the smell from Sawmill Run," said the physician, as the two paused on the river bank, above turbid waters laden with cans, boards, and the scum of slaughterhouses and stables. "I have reported that to the Health Board time and again," the doctor went on, "but they don't mind. The wonder to me is we don't have fever here all the time. But wait. That water is going into the pool at the connecting bridge, where the Monongahela Water Company has just put down its new plant. All that filth goes in that drinking water, for it isn't filtered."

Remembering Hamburg, and in view of the present epidemic of black death in China, this is cheerful news; but its publication will have done some good if it stir up municipal authorities to greater activity in questions of public cleanliness; and—be it added, from the standpoint of this journal—if it prove that in some new, but altogether practical and scientific manner, electricity is life.

AND THERE SHALL BE NO MORE SEA.

TWENTY-EIGHT years have gone by since Captain Anderson and the officers of his cable-laying fleet went to the little church at Heart's Content and there gave hearty thanks to Almighty God for the success of their expedition, and for the safety that had attended their long labors on the mighty deep; listening, also, to a sermon from the apt text: "There shall be no more sea." Resuming the unfortunate work of 1865, the "Great Eastern" had now accomplished her noble task of mooring the new world alongside the old with electric cables; and the modern era of uninterrupted, instantaneous communication between the two hemispheres had begun. To-day there are twelve North Atlantic cables, the fifth Anglo-American being the

last. It is a remarkable and happy coincidence that on Friday, July 27th, this latest Anglo-American cable should have been completed—the same day of the week, the same day of the month, and the same month of the year that witnessed the memorable accomplishment of the pioneer work in 1866, at the peaceful inlet now known to all men, in all parts of the world, as Heart's Content.

Not only did the cable layers of 1866 return thanks but they indulged in joyous celebration. The present writer has a well-worn copy of an extravaganza performed on board the "Great Eastern" just after the event, neatly entitled "A Field Glass," and it brims over with enthusiasm and fun. The twelve long years of wearisome disaster and defeat had ended, and it was time for bumpers and congratulation. But the cable art has advanced, for what had from first to last consumed twelve years is now done practically in twelve days. In laying the fifth Anglo cable, the "Britannia" and "Scotia" have in reality done their work inside of fourteen days. Moreover, the cables of to-day are far heavier than their predecessors. Four hundred pounds of copper to the mile with four hundred pounds of guttapercha was once good enough, but this last cable has no less than 650 pounds of highest purity copper with insulation to match. So much copper ought to carry "Morse."

The Atlantic is now well provided for. Let our cable capitalists and experts turn their attention to the Pacific, where to-day the only two people in Asia who amount to anything are at war, where a new Republic has been set up, and where a new Commonwealth is getting itself together, but where the cable conditions are little better than those existing in the Atlantic in 1866. There is still a good deal of sea between us and the lands of the Pacific.

UNDERGROUND ELECTRIC RAILROADS.

THE summary given in this issue of underground electric railroad schemes and actual construction, in London, would indicate that that city is destined soon to have a very extensive service of the kind. The City & South London road has entirely proved the feasibility of such a system, and has also suggested many improvements and modifications; but all these new roads will go down very deep. The old London steam underground provides about eighty miles of road, but the electric service bids fair to be quite as large and much more popular.

In the meantime, little or nothing is being done in this country, on similar lines, to relieve the congestion of city passenger traffic. After years of investigation, New York is to-day practically without a proper plan providing for the future, and the only relief comes from the extension of trolley and cable systems and the express third track on the elevated. Boston, however, has secured a combined plan of elevated and subway road, but the elevated is of a novel single rail, inclined wheel, construction that engineers regard askance; and it is said, with regard to the underground, that Bostonians will not be able to endure in summer the rapid change from the hot streets to the cool subways. We confess our inability to sympathise with the latter criticism at a moment when any place of shade is a refuge from the prevailing temperature of 100°; but there may be something in it. Boston and New York cannot too quickly relieve the congestion that now afflicts their business centres morning and night; and what is needed is less official reporting and more active work at one system or another.

INCANDESCENT LAMPS: THEIR USE AND ABUSE.¹

BY A. D. PAGE.

In the present state of the art of incandescent lighting, in no way can central station managers increase the efficiency of their investment more than by careful study of ways and means of operating lamps in a manner which will insure an average maximum light for a minimum expenditure.

Too large a percentage of central stations judge the quality of

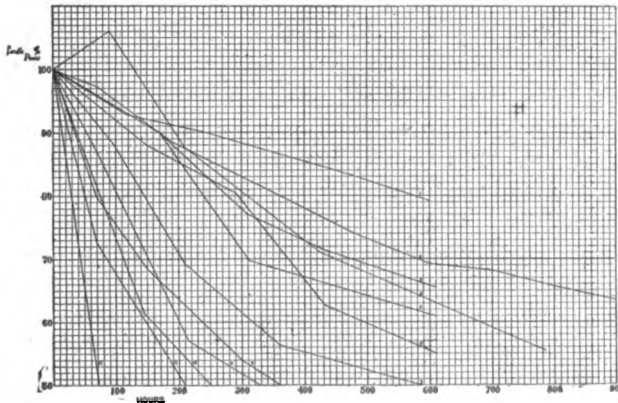


FIG. 1.

amps sold them almost entirely by their life, and even that poor basis of calculation is still further distorted by keeping no ampere records nor averaging results, but judging solely by the individual records of such lamps as may fail in the first hundred hours, or of those which live hundreds of hours past the point, at which, from an economical standpoint, they should have been broken. The importance to central station managers of judging lamps which are sold to them from some better basis than individual or even average life, can be better appreciated by referring to Diagram No. 1, showing curves of deterioration in candle power of lamps manufactured by different companies. (In considering deterioration in candle power, it should be stated that it is a characteristic of every lamp which has yet been manufactured and should be considered entirely independent of blackening or discoloration of the bulb. Lamps may deteriorate to 50 per cent. of their initial candle power within two hundred hours and still show scarcely a trace of blackening.) All lamps, the curves of which are shown, were purchased within six months in the open market in lots of from ten to twenty-five, and the curves are the average result obtained by starting each lamp at the particular voltage which would bring the lamp to exactly 8 watts per candle, maintaining the voltage constant throughout its life.

Curves Nos. 8, 5 and 6, Diagram No. 1, represent the best results obtained from the product of numerous foreign manufacturers. Nos. 4, 8, 9, 10, 11 and 12 each represent a different domestic manufacturer.

While there is no reason to suppose that the average life of lamps shown by Nos. 4 and 7 will be shorter than that of lamps represented by Curves Nos. 10, 11 and 12, there is also no certainty that it will be longer, and if a lamp is to be branded as poor by the central station manager, because of the breakage of a small percentage of lamps in the first one hundred hours, then the advantage is in favor of the lamp which reached 50 per cent. of its original candle power in the first two hundred hours, thus maintaining the carbon at a high degree of incandescence with the necessarily greater strain of the filament for only a few hours.

The carbon which maintains its candle power must continue to burn at a higher temperature, nearer the point of vaporizing, and is more likely to be destroyed by an abnormal increase in pressure than one which cools within the first few hours to a point where considerable increase in voltage is required to bring it to its initial degree of heat or incandescence.

From the standpoint of the central station, one of the worst guarantees that you could demand from the lamp manufacturer would be an individual life (for each lamp) of one or two hundred hours. The reason for such demand, when made on your part, arises from the erroneous impression that the lamp which lives only one to two hundred hours is necessarily defective. Nearly every lamp sold you, and particularly those which show the best results, rises in candle power for the first few hours (this is not shown in Diagram No. 1, as in only one case was the first test after the lamps were started made before the candle power commenced to drop).

On nearly every central station, particularly on alternating current stations, during light load, the pressure on the primary is

abnormally high. Add to this the difference between drop in the transformers and secondary wiring, as between full and light load, and the result which a test is quite certain to show, is pressure on the one or two lamps which the customer is burning during light load from 6 to 10 per cent high.

Referring to Diagram No. 2, we find that burning a new 16 c. p. $3\frac{1}{2}$ watt lamp 7 per cent. high would, for the first few hours, raise its candle power to 25, and its efficiency to about 2.6 watts per candle. In less than one hundred and fifty hours, even maintaining the high pressure mentioned, the candle power and efficiency would fall below normal; but in the meantime, the new lamps which have been burned under the above conditions have been abused to an extent which would be quite certain to make the showing of some individual lamps very poor, *through no fault of the lamps.*

After lamps have been in use about two hundred hours, under average conditions, they could then be used where the pressure was high, without bringing the carbon to a dangerous degree of incandescence.

One of the best illustrations I can give of the importance of your judging lamps from some better standard than simply life, is to refer to an incident of which I had reliable information where a representative of the lamp company, who manufactured the lamps shown by Curve No. 12, Diagram No. 1, exhibited the valuable quality possessed by his lamp standing very high pressure. With a rheostat it was exhibited burning from normal to a very high candle power. He represented it as the *toughest* filament ever placed in a lamp, and I have no cause to disbelieve him.

If central stations run with a variation of from 6 to 20 per cent. in pressure they will find it necessary to demand *tough* lamps, the natural product of the *amateur* lamp manufacturer. To bring a product up, however, even from Curves Nos. 9, 10 and 11 to No. 4, means experience and thousands of dollars spent in experiments.

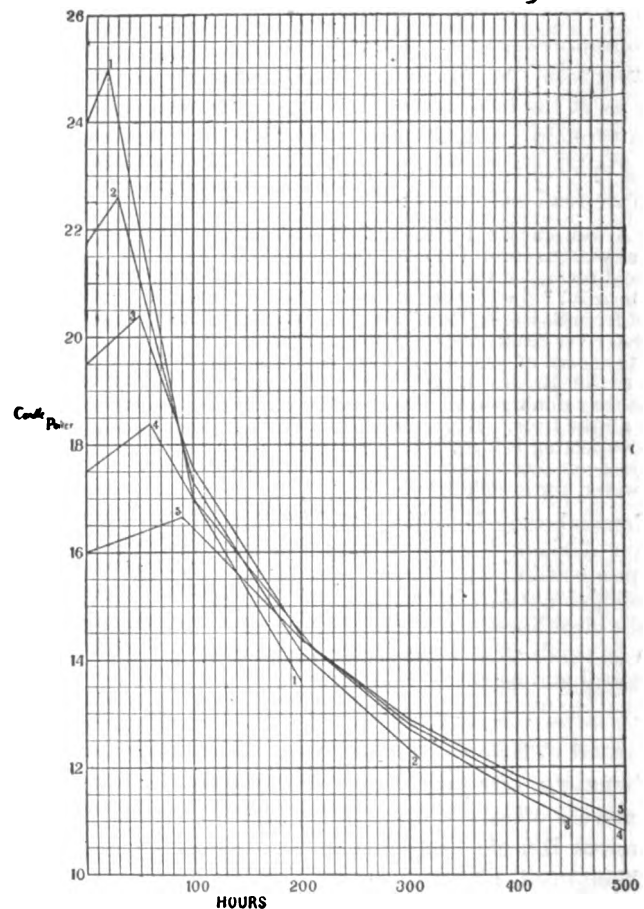


FIG. 2.

It also means that each one of over fifty different operations through which the parts of a lamp pass from start to finish, should receive careful, intelligent handling or direction. Perfection in any one particular will not attain even average results.

The manufacturer of lamps shown by Curve No. 4 might have furnished the same carbons to manufacturers of lamps represented by Curves Nos. 10 and 11, and the result which they would obtain would not differ materially from that secured with their own make of carbons. Curve No. 4, though it represents as high

1. A paper read at the second semi-annual convention of the Northwestern Electrical Association, St. Paul, July 18, 19 and 20, 1904.

an average grade of lamp of any voltage above 100 as has yet been furnished to the customers of any lamp manufacturer, does not represent the highest point which will be attained.

Curves Nos. 1 and 2 represent experimental lamps manufactured and furnished for test by the same company, whose regular product is represented by Curve No. 4, and I am informed by reliable experts that within a few months the entire product of the company will be brought up to the standard represented by Curve No. 1.

That the relative value of the lamps represented by these curves may be fully appreciated, let us take the average candle power of Curve No. 1, Diagram No. 1, which for six hundred hours is 1419 candles, and we find, to maintain the same average

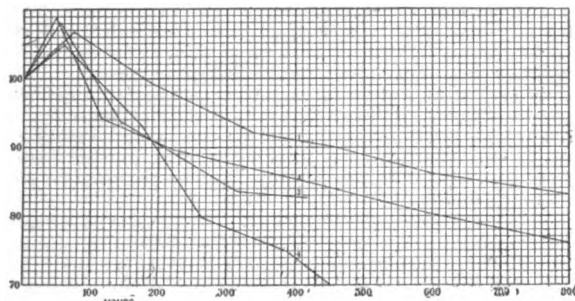


FIG. 3.

candle power, using other lamps, we should have to break lamps represented by Curve No. 4 at five hundred and thirty hours; No. 7 at one hundred and seventy hours; No. 8 at one hundred hours; No. 9 at one hundred and twenty hours; No. 10 at ninety hours; No. 11 at seventy-five hours, and No. 12 at thirty-five hours.

All of the lamps represented by Diagram No. 1 are of voltages from 100 to 125 volts, and though started at a higher economy (vs. 3 watts per candle) than is commonly practiced by central stations (the 3.1 standard of Edison illuminating companies being the highest of which I have personal knowledge). Testing at 3 watts comes nearer to results obtained by commercial practice than a lower initial economy, as the tendency of the average central station is to run high.

Diagram No. 3 represents lamps of from 50 to 60 volts, started at 3 watts per candle, and tested under the same conditions as the 100 to 120 volt lamps.

No. 1 is the product of the same factory as Nos. 1, 2 and 4, Diagram No. 1.

No. 2 was manufactured by the same company as No. 9.

No. 3 was manufactured by the same company as No. 11.

No. 4 was manufactured by the same company as No. 10.

As proven by these curves, and also, I believe, as generally acknowledged, it is much easier to produce a fairly good 50 volt lamp than one of a voltage above 100; but, considering the progress which has been made within the past year in the high-volt lamps, I believe that in a short time a large percentage of alternating current central stations will find it to their advantage to use large transformers and secondary mains on the three-wire system, covering one or more blocks from one transformer or bank of transformers and using only lamps of over 100 volts, thus greatly economizing in copper and securing much better regulation than is now secured with numerous small transformers and 50 volts on the secondary.

The importance of good regulation or a constant voltage at the lamps is too little appreciated, the general opinion of central station managers apparently being that so long as the life of the lamp is satisfactory to themselves or their customers, if they increase the voltage either temporarily or permanently, the result would be to increase the average light. The facts are that burning lamps above their normal rating decreases the entire average candle power on the customers' circuits and at the same time, if the station is on a meter basis, increasing the amount of the customers' bills. The above statement is particularly true of lamps only of average quality.

Referring to Diagram No. 2, No. 5 curve represents a 108 volt, 16 c. p., $3\frac{1}{2}$ watt lamp burned at a constant voltage and reaching 11 candles at five hundred hours, starting the same lamp at 110 volts or at $17\frac{1}{2}$ candles, 3.3 watts per candle, and inside of two hundred hours the candle power curve crosses the one burned at normal. Starting it at 112 volts or at $19\frac{1}{2}$ candles, 3.1 watts per candle, in less than two hundred hours the candle power curve crosses both the others.

Curves Nos. 1 and 2, follow the same general law. The higher we raise the voltage the more rapid the drop in candle power, and when we consider that the lamp represented by Curve No. 1 must be kept at 116 volts in order to give 14 candles of light after two

hundred hours, and that should the voltage be brought back to normal or 108 volts, the candle power would be only about 9 candles, we can appreciate that on a station where the voltage varies even 7 per cent, the result must be a very uneven and poor quality of light, even though the life of the lamp is satisfactory.

The tendency of all central stations seems to have been to gradually raise their voltage with the intention of thus either burning out or increasing the candle power of the old lamps on their circuits. The result is only to either burn out an abnormal number of new lamps or bring them down to the candle power level of the old ones within two hundred hours.

The only practical method of keeping the average candle power of lamps on a station at a point which will be satisfactory to customers or on a competitive basis with other methods of lighting, is to keep records of the average life on the entire station where free renewals are furnished, and then to take out of the sockets and break up all lamps which are dim, by this means keeping down the average life to whatever constant is decided as the best under local conditions. Where lamps are sold to customers, to keep the candle power of lamps in use on the circuit of a central station at a point which will insure satisfaction or tend to keep the electric light popular, is a difficult problem. Whether the customer is on a meter or on a contract basis, it is poor economy for him to keep lamps in his sockets which are giving only 50 per cent. of their initial candle power, but for the corporation which sold him the lamps and supplies him with current, to call his attention to the fact that lamps in his sockets are giving only about 8 candles, and attempt to sell him lamps at 50 or 60 cents each, is not likely to bring about the desired result. To meet the above difficulties a number of central stations in different parts of the country are now selling lamps at retail to their customers at cost and a few stations even below cost, at the same time doing all in their power to prove to them that only by a liberal use of lamps can they obtain the greatest amount of light for a given expenditure of money.

As the profit on the sale of lamps is decidedly a secondary matter as compared to the sale of current and the increased quality of the light, the above plan should commend itself to all central stations not on the basis of furnishing free renewals. It is also worthy of consideration that by adopting the above plan the station controls what lamps shall be used on its circuits without dictating to its customers, an important point while lamps show such widely different results as those shown by Diagram No. 1; and while customers continue more likely to believe that the corporation is not supplying proper current, than to believe that the quality of lamps they have been purchasing is at fault.

Another method of inducing customers to destroy dim lamps which has found favor with a number of stations, is to make a price for lamps of say 40 cents each and agreeing with their customers to exchange all dim lamps (which they have sold them) at half price, that is, for every dim lamp which the customer

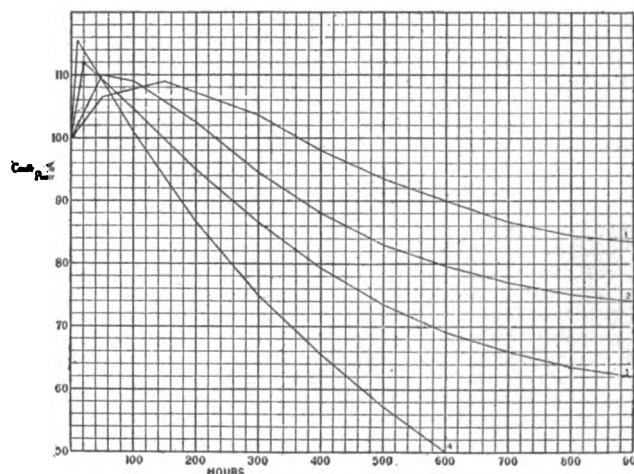


FIG. 4.

returns before the carbon is burned out, he receives a new lamp for 20 cents.

Within the past few months the question has often been asked me by central station managers, "What economy of lamps should we use?" This question should, I believe, be settled by central station managers themselves on presentation of facts, they having control of the regulation of their station and knowledge of local conditions.

Diagram No. 4 shows the same quality of lamp manufacture as Curve No. 2, Diagram No. 1; and represents 16 c. p. lamps started at an initial economy of 4, $3\frac{1}{2}$, 3 and $2\frac{1}{2}$ watts per candle. The accompanying table shows candle power, average candle power,

average economy and average candles per electrical horse power at one hundred hour periods in their life.

	64 Watts	56 Watts	48 Watts	40 Watts
100 Hours	C.P. 17.28 Average C.P. 16.8 Average Watts Per Candle 3.9 Candles Per E.H.P. 191	17.44 17.06 3.28 227	16.8 17.09 2.8 266	16.16 16.96 2.36 316
200 Hours	C.P. 12.12 Average C.P. 17.03 Average Watts Per Candle 3.76 Candles Per E.H.P. 198	16.32 16.94 3.3 226	15.2 16.51 2.9 257	14.08 15.97 2.5 298
300 Hours	C.P. 16.64 Average C.P. 16.96 Average Watts Per Candle 3.77 Candles Per E.H.P. 198	15.04 16.53 3.39 220	13.92 15.86 3.03 246	12 14.96 2.07 279
400 Hours	C.P. 15.68 Average C.P. 16.74 Average Watts Per Candle 3.82 Candles Per E.H.P. 195	14.08 16 3.5 213	12.8 15.2 3.16 236	10.56 14.03 2.85 262
500 Hours	15 16.45 3.89 192	13.28 15.57 3.59 208	11.68 14.62 3.28 227	9.12 13.2 3.03 246
600 Hours	14.40 16 4 187	12.8 15.15 3.7 202	11.04 14.08 3.41 210	8 12.43 3.22 232
700 Hours	13.92 15.84 4.04 185	12.32 14.78 3.79 197	10.56 13.63 3.52 212	
800 Hours	13.6 15.6 4.1 182	12 14.45 3.88 192	10.24 13.23 3.62 206	
900 Hours	13.28 15.36 4.17 179	11.84 14.18 3.94 189	9.92 12.88 3.73 200	

In considering these curves and table it should be remembered that the result would have been much less favorable to the higher economy lamps had the test been made and the curves plotted with poorer quality of lamp, and also that satisfactory results with lamps of higher economy than $3\frac{1}{2}$ watts per candle can only be obtained by exercising the greatest care in maintaining a constant voltage at the lamps. Referring to the table briefly, it will be found that even at six hundred hours, lamps of the highest initial economy show the best average result as to average watts per candle and average candles per horse power. And that at nine hundred hours 8 watt lamps show better average results than lamps of 3.6 or 4 watts. The greatest objection which can be urged against the high economy lamp is that while at nine hundred hours the 4 watt lamp reaches a minimum candle power of $13\frac{1}{4}$ candles and the $3\frac{1}{2}$ watt lamp about 12 candles, the 8 watt lamp reaches 10 candles and the $2\frac{1}{2}$ watt lamp at six hundred hours reaches 8 candles. At the present price of lamps, where fuel is high and the customers' bills are made up on the basis of lamp hours, it would, without question, pay the station to use high economy lamps, breaking them at a point which would insure satisfaction as to average light and keeping the average life comparatively short.

Whatever economy or make of lamp you decide to use, by no means can you so greatly increase the efficiency of your station as by making every possible effort in the direction of maintaining a constant voltage at the lamps. This can only be accomplished and maintained by constant use of reliable, portable instruments. No switchboard instrument should be relied on, without often checking it by some reliable standard, and it should also be borne in mind that, owing to the varying drop at various loads, constant voltage at the station is just what is not wanted. If you do not possess a reliable, portable volt-meter, such an instrument should be your next purchase, then by constant use on your circuits at different loads and *profiting by the knowledge thus obtained*, you would soon find a marked improvement in your lighting and would be in a position to judge which make and what economy of lamp is the best for you to purchase.

THE MONTGOMERY ELECTRIC LIGHT AND POWER COMPANY has been incorporated at Montgomery, Ill., by Lyssander Hord, Jr., Jno. S. Habermeyer and Wm. C. Weise; capital, \$10,000.

ELECTRICITY AS A FIRE HAZARD.—V.

BY W. J. JENKS.

ORIGIN OF ELECTRICAL INSURANCE RULES.

In connection with the third of the series of reports, Mr. Atkinson printed a code of "Directions for Running Wires for the Edison Incandescent Electric Light," issued by the Edison Electric Light Company, of New York City, over the signature of C. L. Clarke, of its engineering department, and dated "February, 1882." Among these directions occur the following:

"Whenever a connection is made between a larger and smaller conductor at the entrance to or within the building, our automatic device (the 'safety catch') must be introduced in the circuit of the smallest conductor so as to cut off the current when in excess of the safe carrying capacity of the conductor. The safe carrying capacity of a wire is that current which it will convey without increasing its temperature more than a few degrees above the temperature of the room through which it passes.

"All wires, machines and lamps to be so mounted and secured as to insure complete and continuous insulation, with the exception of those parts (such as portions of the lamp or machine, for example) where insulation is impossible, and, in this case, accidental contact with exterior objects must be prevented by appropriate screens or the like.

"In no case must 'ground circuits' be employed or any portion of the system allowed to come into conducting connection with the earth through water or gas pipes or otherwise.

"All wires should be placed at a distance of two and one-half inches from each other, and, wherever they approach any other wire or conducting body capable of furnishing another circuit or ground connection, they must be rigidly secured and separated from the same by some continuous solid non-conductor, such as dry wood, of at least one-half inch in thickness.

"Wherever wires are carried through walls and floors in buildings, they must be surrounded by a special tube or substantial material, and insulated therefrom.

"All joints in wires must be made in such a manner as to secure a perfect and durable contact, and means provided to prevent their contact with any other conducting body."

The "indefinite sense of danger," as Mr. Atkinson expressed it, which at that time pervaded the community, was indicated a few days prior to the reading of the paper by Mr. Anderson from which I have quoted, in an editorial in the "New York Times," of October 28th, 1881. Referring to reported narrow escapes from fires due to the imperfect insulation of electrical conductors, the writer said:

"These are but typical examples of what may be expected when the electric lamp comes into more general use, unless a more perfect and more durable mode of insulation is adopted than that of merely winding the wire with thread or cord, or sheathing it in vestments woven of the same perishable material, liable to become rotten in a short time through the action of the elements, or to be worn away by the sharp friction in a few hours.

"If employed in house lighting, they should be carefully boxed—not exposed to abrasion from any accidental cause.

"Perfect insulation cannot obviate the danger from fusion by over-heating; indeed, the more perfect the insulation, the greater the peril."

Referring to the "Times" article, and in startling contrast with its conservative views, was an emphatic utterance by one of the learned authorities of that period in a reply written a few days later:

"In the first place, let me remark that I fully realize that fires may be caused by the wires carrying the currents used for electric lighting of all sorts, but the conditions of danger are not correctly set forth by the writer of the article in question. In the first place 'the conductor coming in contact with wood-work' will not, as this writer says, 'almost instantaneously ignite it.' On the contrary, it is perfectly safe to have such wires secured with metal staples directly to the wood-work of a building for any distance. The electric current used with these wires is so immensely within the limits of their conductivity or carrying power that it has not the slightest practical tendency to escape, or to heat the wires through which it passes.

"If the wire should be nearly severed or imperfectly connected at any point, then heating and danger may occur at such point as suggested, but the intact wire is as little liable to ignite wood-work along which it runs, as a gas pipe would be, and the latter equally might occasion fire when it is defective and leaking, though the bad smell of the gas decreases its dangerousness in this respect."

There are several propositions here laid down to which the intelligent insurance inspector of to-day would hardly assent.

From some of the above quotations it is plain that the low pressure systems had, in the opinion of the fire insurance people, provided to a certain extent against the over-heating of conductors and the consequent ignition of their insulating covering, by interposing a safety fuse in the circuit of each branch which

diverged from a conductor of larger size, and that they relied upon this fusible section, or weak link in the chain, to protect the circuits and apparatus from the difficulties of leakage and from the fires which might result.

It must be understood, however, that this feeling of confidence was based upon the idea that, in following the rules from which I have also quoted as being issued at the same time, the conductors would be separated from any foreign conducting material, such as a gas-pipe, by at least one-half an inch in thickness of a good insulating material of rigid character, such as dry wood. It is also worthy of note that in the code of "directions" just quoted, there is not a word said about the fixtures to which incandescent lamps were to be attached, leaving the presumption that when such fixtures formed part of a conducting system, the wires of the circuit were to be insulated from them with as much care as if they incidentally crossed a gas pipe or a water pipe in their course through a building.

Acting upon their earliest impressions that an insulating covering which would not burn if the wire became red hot (or at all events would not carry fire or support combustion) would answer the purposes of electric lighting, the fire insurance authorities approved a form of insulation consisting of one or two thicknesses of cotton braid saturated with white paint or a similar compound. Conductors thus insulated soon became known to electrical men as "underwriter's wire." They undoubtedly did possess the advantage of being non-inflammable, but it soon became equally notorious that when placed in many positions they would not in any appreciable degree prevent electrical leakage, because they would absorb moisture almost as readily as a sponge. The difficulties which the absorption of moisture might occasion were understood by comparatively few people who were really engaged in the business of construction, but they soon became evident when small leakages through the insulating covering and across a bridge of moisture-covered or moisture-soaked intervening material to a ground connection or a wire of opposite polarity, developed first a charring of any combustible substance along which the leakage might be conducted, and afterward a blaze. There was, however, in these early years very little choice offered to the constructor in the matter of conductor insulation. The ordinary paraffine wire used exclusively for interior work in the earlier days of the telephone industry speedily revealed the volatile character of the insulating filling of its cover by drying out and leaving a simple braid or winding, no protection against moisture. A similar woven cotton cover filled with beeswax was but little better and also very inflammable. A variety of rubber-covered wire, known to the trade as "Kerite," had been used in prior low-pressure work where the small currents of the telegraph and its kindred systems had been employed, but when exposed to the action of the elements, or to the heat of the upper portions of rooms, it speedily became brittle and was often found cracked to the metal beneath.

Such were the insulating flexible coverings with which the early electric light constructor attacked the problem of wiring fixtures for incandescent electric lamps alone, or fixtures providing for both gas and electricity and also the general work of wiring buildings. Their use tended from the first to convince the experimenter of the early months and years of the electric lighting art that the safest method, even in the handling of low-pressure currents, such as those required by the incandescent lamp, consisted in dependence upon the precautions set forth by the directions of the Edison company which I have quoted, namely, the separation of all such insulated conductors from any foreign conducting body, such as a gas pipe, by at least half an inch in thickness of a rigid insulating material like dry wood, and reliance upon supports of this kind and the aerial suspension from one support to another which this method allowed, in the running of wires along the main stem or the arms of a gas fixture.

ELECTRIC HOSE SIGNALING IN BOSTON.

Tests were made in Boston recently, with some success, of an electric fire hose signal. The hose contained two insulated wires, running through the fabric and fully protected from external damage, and wholly clear of the waterway. These were fastened into the metal couplings, between the several sections, and the couplings were so constructed that when screwed up in the ordinary way the electrical connection was complete. A push button was placed in the coupling, to which was attached the nozzle. By pressing this the hoseman at once communicates with the engineman at the apparatus, and he can convey any information in this way that may be arranged by an established code of signals. The necessary bell was placed on the engine, the electrical force being supplied by a dry cell battery. During the trial, water was shut off and received at the nozzle in two seconds after the electric signal was made, the hose having first been filled.

It is evident that with such a system water and water damage may be saved, and that men at the hose will have control at every instant over the water supply. There will also be less shouting and confusion.

THE WORLD'S FAIR IN MINIATURE.

THE "Scenograph," Mr. E. J. Austen's reproduction of the World's Fair at the Madison Square Garden, is an extremely artistic and realistic commingling of art and artifice. It represents the Fair from an imaginary balloon or cloud or something about 600 feet above the waters of Lake Michigan, so that one looks down upon the Court of Honor with the Pier and the Peristyle in the immediate foreground, and the Administration, Manufactures, Agricultural, Electrical and Machinery buildings in the middle distance. The mushroom addition to the "South Side," that sprang into existence to accommodate the imaginary millions who were expected to inundate the town, is seen beyond the walls; to the right the smoke of the city proper hangs above the tall, dingy buildings, and beyond on all sides stretches the prairie. The more important buildings are actual models built to scale, and the larger part of the grounds is also laid out in walks and grass plats, lakes and inlets. The water of the lake, nearest the spectator, is also real, and laps against the sea wall or rolls in mimic surges along the beach in the most lifelike way imaginable.

An Intramural railway train winds through the grounds now and then and the "whaleback" and one or two other steamers move about the lake and stop at the long pier for passengers. The rest of the scene is painted, and so clever is the illusion that it is impossible to tell the real from the canvas. In some instances part is real and part pictured—notably, in the case of the lake, where, at the extreme right, the water stops and the painting begins without break or line—a bold and masterly piece of scene painting.

When the visitor first sees all this the time is supposed to be about mid-day. Presently, however, it grows less bright, and a faint glow is seen beyond the western horizon, increasing as the daylight fails, until the whole sky is aglow with sunset. Then darkness comes and lights begin to glimmer in the building and about the grounds and beyond in the city, and the boats on the lake show their signal lanterns and light up their decks and cabins, and the electric fountains play with changing colors, and the search light on the Manufactures building shoots its tongue of light across the basin to illumine the MacMonnies fountain, or off to the Plaisance where the Ferris wheel is slowly and ponderously turning—and we have the Fair at night. Then the dawn breaks and the whole thing has to be gone over again!

It is, of course, natural that all these changes should be brought about by electricity. Mr. D. J. Buckley, the electrician who has done so much scenic work in Chicago, for the ill-fated McKaye Spectatorium and similar enterprises, has had complete charge of the electrical equipment and has produced a most creditable result. Current is taken from the plant supplying the theatre and garden and is led to separate rheostats for the various circuits. At the horizon line there is a break in the canvas—that on which the sky is painted being about a foot behind that representing the prairie—and in this space, just below the horizon, is a row of white and colored 16 c. p. lamps for the sunset effects. There is no main switchboard, but each circuit is made as short as possible and is operated from an individual rheostat and switch. The buildings are lighted by a few large lamps instead of many small ones; thus, instead of the Administration dome being covered with rows of miniature lamps, three 32 c. p. lamps are placed inside and shed their light through openings corresponding to the incandescent lamps and the gas flambeaux in the original.

The two electric fountains are lighted from below and the beams shoot upward, coloring the water jets as they play, and reproducing, as nearly as so small a model can, the beautiful results that afforded a never ending source of delight to thousands of people nightly last summer. The searchlight consists of a small incandescent lamp with a reflector, inclosed in a cylinder. It is too large, however, and is out of proportion and out of keeping with the rest of the scene, and will, doubtless, be changed. The lighthouse at the life-saving station is much better and flashes most naturally at regular intervals.

The vessels on the lake are operated by little Porter motors supplied with current by flexible cords incased in rubber tubes which they drag after them. To keep them in the proper course a track is laid on the bottom of the lake and the boats have guides in their bottoms fitting upon the track. Thus no steering is necessary and the navigating appears to be most skillful. As they come up to the pier an automatic cut-out breaks the circuit and they remain moored until current is again turned on.

The scenograph is built for "the road," and everything about it is as simple as possible and so designed as to be easily taken apart and set up. From an electrical engineering point of view it is no great feat, but it is, nevertheless, an extremely skillful piece of work, and deserves to succeed during its proposed trip about the country.

MEXICO.—It is stated that a concession has been granted to J. T. Commegare for a subway telephone system for the City of Mexico. Free instruments are required for government offices, and the rate to subscribers is not to exceed \$4 per month. There cannot be much money in that.

LEGAL NOTES.

STREET CAR STOCK LIABILITY TO TAXATION—BROOKLYN TRACTION CO. vs. CITY OF BROOKLYN.

THE BROOKLYN TRACTION COMPANY reviewed on writ of certiorari the Assessors' act in fixing the assessed valuation of its property for 1898 at \$1,015,500. General B. F. Tracy claimed that the Traction Company had no real or personal property subject to taxation, its personal property being invested in the capital stock of the Atlantic Avenue Railroad Company, which had already been assessed. Judge Gaynor, who heard the argument, gave judgment for the Traction Company, with this opinion: "All lands and personal property whether owned by corporations or individuals, are alike liable to taxation. (2 R. S., part 1, ch. 13, title 1, sec. 1.) The property of a corporation is the same as the capital of an individual, and each is subject to the same taxation. It is not the paper certificate of shares of capital in a corporation that are taxed. They merely represent and evidence the distributive portions of the capital, or substance, of the company, which would go to the different share owners upon the dissolution of the company; and it is this capital or substance which is taxed. The actual property, not the paper certificates representing it, is what is taxed. To tax the property, and then the paper certificates representing it, would be taxing the same property twice. It would be the same as taxing so many acres of land, and then taxing the title deeds of it. But our tax laws allow no such thing; nor is there anything in them to suggest or make credible that assessors might ever attempt to do the like. Indeed, as if to preclude the possibility of it, the Legislature expressly made the 'owner or holder' of stock in any corporation which is liable to taxation on its capital, not liable to be taxed for such stock (2 R. S., part 1, chapter 13, title 1, section 7); obviously meaning the paper certificates of the shareholder, and not the proportion of the property, real and personal, of the corporation, represented by them, for the title to that is not in shareholder at all and it is therefore taxable against the corporation. (2 R. S., part 1, ch. 13, title 1, sec. 1.) The relator, the Brooklyn Traction Company, is the owner of shares of stock in the Atlantic Avenue Railroad Company. It may no more be taxed upon said shares than may any other owner of shares in the said company be taxed upon his shares. This is obvious; but nevertheless the legislature in a spirit which, except for the occurrence of this case, would have to be deemed needless caution, has commanded assessors in the marshalling of the assets of corporations for taxation to exclude or deduct all shares of stock owned by them in corporations whose capital is taxable. (Laws 1857, ch. 456, sec. 3.) Judgment for the relator, with costs and disbursements.

ANGLO-AMERICAN TELEGRAPH COMPANY (LIMITED) vs. COMPAGNIE FRANCAISE DU TELEGRAPHE DE PARIS A NEW YORK.

The long-protracted proceedings in the action brought by the English Company against the French Company, claiming damages for loss sustained in consequence of the rupture in 1887 of the "common purse" agreement made six years previously, was brought to a close recently, when the final judgment of the Court of Appeal was, as was anticipated, in favor of the Anglo Company. The Court held that the Pouyer-Quertier Company should have sought the approval of the French Government before breaking the agreement, failing which it acted on its own responsibility and at its own risk. But as it was evident by the Ministerial dispatch of May 21, 1891, that the French Government would not have given its consent to the fusion of the two Companies, the Anglo Company were only entitled to damages for any injury it might have sustained through the rupture for the period between December 31, 1886, and May 21, 1891. The Court was not able itself to assess these damages, and therefore referred the matter to MM. Flory and Verbeeque and a third person yet to be chosen, to determine the amount to be paid as compensation to the Anglo Company. The Pouyer-Quertier Company are to pay all costs up to and including this judgment, the question of further costs being reserved.

EDISON ELECTRIC LIGHT CO. vs. STAR ELECTRIC LAMP CO.—INCANDESCENT LAMP LITIGATION.

THE suit for infringement of the original Edison lamp patent, brought by the Edison Electric Light Co. and the Edison General Electric Co. against the Star Electric Lamp Co. and its individual officers, was argued before Judge Seaman at Chicago on Wednesday and Thursday, the 18th and 19th ult. Mr. Beal, of Isham, Lincoln & Beal, and ex-Commissioner of Patents Mitchell, appeared for the plaintiffs, Mr. Francis W. Parker being attorney for the defendants. While the suit was similar to the now celebrated Buckeye suit, it differed from it in several details. The defendants state that in April, 1892, they received a formal notice from the plaintiffs, attached to which was a copy of the patent in question, said patent bearing the certificate of limitation making

same expire in November, 1893. Shortly after receipt of such notice and on the strength of it, the defendants completed arrangements whereby they invested some \$50,000 in tools, machinery, etc., and contracts and letters show that they did so on the supposition that the patent would expire in November, 1893. They also entered into contract with plaintiffs, by the terms of which they agreed not to make lamps during the life of the patent. The plaintiffs now claim that the patent has not yet expired and hence the suit. After some able arguments on both sides, occupying two days, Judge Seaman reserved his decision, which is looked for the latter part of this week.

THE STANDARD PAINT CO. vs. HENRY J. BIRD AND JAMES L. REYNOLDS.

The U. S. Circuit Court for the District of New Jersey, on July 5th, 1894, rendered a decree in the case of The Standard Paint Co. vs. Henry J. Bird and James L. Reynolds, in which it is adjudged that the assignors of this company were the first persons to produce a paper coated with the solid residuum of petroleum, and combining the characteristics of an odorless, water, acid, alkali and air proof paper, and that the patent under which the company has hitherto manufactured is valid and has been infringed. The Court, by the Hon. Geo. M. Dallas, Circuit Judge, holds that any paper possessing the same essential characteristics and produced by the coating with any material similar to that employed by this company, by whatever name it may be called, is an infringement of the above patent, and that the patent is good and valid in law.

Part of Judge Dallas' opinion is as follows:—"As has been said, the products, i.e., the coating materials, however and from whatever produced, are the same, and by the use of either, the same manufactured article is created, and this in the sense of the Patent Law, constitutes identity. The material itself, not the substance from which it may be obtained, is the gist of the matter. A patented manufacture is infringed by the making, use or sale of any manufacture which possesses the same essential characteristics. It is because it had never been used before, as and for the purpose for which the patentees employed it, that the patent which they obtained is impregnable to assault on the ground of anticipation." The Court, therefore, made a decree giving the plaintiffs a permanent injunction with an accounting.

This litigation has covered a period of four years.

ELECTRIC LIGHT AND METER INSPECTION IN CANADA.

THE "Electric Light Inspection Act" has just been passed by the Canadian Parliament. The following is a summary of its principal provisions:

The commercial unit of supply of electrical energy shall be one thousand watt-hours, or the equivalent thereof in ampere-hours.

Before supplying electrical energy for illuminating purposes to any purchaser, the contractors (electric light companies) shall declare the constant pressure at which they propose to supply energy at his terminals. The variation from the declared pressure shall not exceed at any time 4 per cent, except when due to accident to the generating plant or apparatus, or to the uncontrollable condition of the elements.

The contractors shall be responsible for the maintenance in a proper condition of all electric lines and apparatus belonging to them or under their control upon the purchaser's premises; but, when not under their control, they shall not be responsible for any damages arising therefrom.

If the contractors are reasonably satisfied that grounds exist on the system, they may inspect the wires and fittings on a purchaser's premises upon giving him one hour's notice, and if a ground be discovered having a resistance not exceeding 5,000 ohms the contractors shall forthwith discontinue the supply of energy to the purchaser.

If the purchaser is dissatisfied with the action or tests of the contractors, he may have his wires and fittings tested by an electric light inspector, on application to the Department of Inland Revenue which has charge of the inspection under the Act. The purchaser may also have the pressure of the electricity measured by an inspector.

If the contractors make default in complying with the foregoing requirements, they shall be liable to a penalty not exceeding \$20, for every day of such default.

Any person who maliciously or fraudulently abstracts, causes to be wasted or diverted, consumes or uses any electricity, shall be deemed guilty of theft and be punishable accordingly.

The amount of electrical energy supplied to any purchaser for lighting purposes, shall, if he so desires, be ascertained by a meter.

Meters must have direct-reading dials. Electrolytic meters now in use may be continued, but renewals shall be made with direct reading types.

Meters shall be verified and stamped by inspectors appointed under the Act, but no meter shall be stamped which varies in its readings at full capacity more than 3 per cent. from the legal standard. They are to be verified every five years, but the purchaser or contractors may at any time within the five years require the verification of the meter used, at the cost of the party in fault.

Other provisions of the Act relate to inspection fees, appointment of inspectors, penalties for tampering with meters, granting of certificates, registration of electric light companies, etc. As soon as standards and apparatus have been obtained, the Act is to go into operation upon a day fixed by a proclamation of the Governor in Council, who may from time to time determine at and for what places inspectors shall be appointed; and until inspectors are appointed the Act shall not come into operation with respect to such places.

The Governor in Council may also establish rules and regulations for testing the illuminating power of lamps; for instituting tests to determine what style or make of meter shall be used; and such other regulations as are necessary for giving effect to the provisions of the Act.

LITERATURE.

Die Wechselstrom-Transformator-Anlagen zu Köln und Amsterdam. By Carl Coerper. Cologne, M. Dumont-Schauberg, 1893. 80 pages, 82 double page plates on cardboard, 15x21 inches, and numerous other illustrations. Price \$35.00. THE ELECTRICAL ENGINEER, N. Y.

Mr. Carl Coerper, Director of the Helios Company, has produced in this volume, a work of rare value and surpassing beauty. The first 80 pages are devoted to text descriptive of the two central stations referred to, and also to detailed descriptions of electrical apparatus. The remainder of the volume is filled with superbly executed double page plates showing views of the stations, maps and plans of the cities, distribution diagrams, switchboards, apparatus, etc., in photogravure and colors. The maps and plans show even more than the usual care and skill of the German draftsman, and the photographic work is wonderfully clear and well reproduced. The data also is unusually complete and covers both the electrical and mechanical features of the stations, which are the most important of their class in Europe, and electrical engineers will find the work not only, perhaps, the most pretentious and elaborate yet issued, from a pictorial standpoint, but a valuable addition to central station literature.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS
ISSUED JULY 17, 1894.

Accumulators:—

Process of Making Battery Plates, W. L. Silvey, Dayton, Ohio, 522,065. Filed Sept. 9, 1892.

The method consists in submerging a perforated cathode and a lead anode in a solution of alkali and acetic acid and depositing metal from the anode in the perforations of the cathode, and afterward subjecting them to pressure.

Alarms and Signals:—

Thermostatic Alarm, C. Cuttriss, New York, N. Y., 522,972. Filed Oct. 26, 1893.

Depends for its operation upon the expansion of a confined body of air and is provided with an outlet closed by a porous substance.

Electric Signaling Apparatus, W. W. Hibbard, Rochester, N. Y., 523,120. Filed Aug. 12, 1893.

An electric fire alarm box signal system.

Electric Signaling Apparatus, W. W. Hibbard, Rochester, N. Y., 523,121. Filed Aug. 12, 1893.

Similar to No. 523,120.

Differentiating Apparatus for Electric Signal Systems, W. W. Hibbard, Rochester, N. Y., 523,122. Filed Aug. 12, 1893.

A differentiating apparatus at the central station capable of changing the circuit to enable signals to be sent over the main line to different points without interfering.

Electric Signal Box, W. W. Hibbard, Rochester, N. Y., 523,123. Filed Aug. 12, 1893.

Relates to a special construction of fire alarm signal boxes.

Electric Signal Box, W. W. Hibbard, Rochester, N. Y., 523,124. Filed Aug. 12, 1893.

Similar to No. 523,123.

Magneto Call Box, C. E. Scribner, Chicago, Ill., 523,132. Filed Nov. 6, 1891.

Conductors, Conduits and Insulators:—

Electrical Connection Cord, A. H. McCulloch, Boston, Mass., 522,999. Filed Feb. 6, 1894.

Consists of a non-conducting tube containing a column of mercury.

Electric Conductor, G. H. Blakesley, Bristol, Conn., 523,160. Filed Apl. 7, 1893.

A flexible cord for incandescent lamps consisting of a flat tape at the edges of which the conductors are placed, and having eyelets at intervals along its centre line from which the lamp may be suspended by means of a hook.

Distribution:—

System of Electric Distribution and Generation, E. J. Houston, Philadelphia, Pa., 522,986. Filed Nov. 17, 1897.

Consists of a generator of low E. M. F., an induction coil with low tension primary and high tension secondary, commutators in both primary and secondary, the latter acting in unison with former, and condensers across the terminals of the commutator and the primary.

Dynamoes and Motors:—

Method of and Apparatus for Transforming Alternating into Continuous Currents, J. F. Kelly, Pittsfield, Mass., 522,988. Filed Jan. 6, 1894.

The method consists in collecting such fractional portions of the electromotive forces as shall vary as the sines squared of the current phases, and superimposing them.

Commutator for Dynamo Electric Machines, E. Thomson, Swampscott, Mass., 523,019. Filed Feb. 10, 1894.

Employs a series of sub-segments held in place by an insulated band, in combination with an outer set of wearing segments secured to the sub-segments.

Armature Bar and Method of Making Same, C. Weber and C. W. Marcey, New York, 523,027. Filed Dec. 22, 1893.

The method consists in wrapping the bar with mica paper and then subjecting it to heat and pressure.

Electric Motor, J. F. Denison, New Haven, Conn., 523,140. Filed April 6, 1894.

Relates to the mechanical construction of electric motors and has for its special object to lessen the cost of manufacture.

Means for Ventilating Armatures, T. C. Coykendall, Rondout, N. Y., 523,161. Filed Oct. 17, 1893.

Employs a pulley with fan blades on its inner face forcing the air toward the armature.

Magneto Electric Machine, E. Tilmann, New York, N. Y., 523,247. Filed Nov. 22, 1893.

A small generator adapted to be driven from the wheel of a cab, bicycle or other vehicle, and supplying current to miniature incandescent lamps.

Galvanic and Thermo-Electric Batteries:—

Galvanic Battery, G. Hewett, New York, N. Y., 522,983. Filed Sept. 19, 1893.

A gravity battery having a carbon porous cup containing bichromate of potash crystals and a solution of bisulphate of soda outside of the porous cup.

Lamps and Apparatuses:—

Manufacture of Incandescent Electric Lamps, H. D. Burnett and S. M. Doane, Swampscott, Mass., 522,864. Filed Dec. 3, 1892.

Claim 1 follows:

A fork for the manufacture of incandescent electric lamps, provided with a screw threaded tang, and a handle of non-conducting material having a screw threaded socket to engage with said tang.

Electric Arc Lamp, W. E. Frost, Lewiston, Me., 523,141. Filed July 31, 1893.

Relates to the construction of the clutch rod and feeding mechanism.

Incandescent Electric Lamp, W. E. Forest, New York, 523,204. Filed Aug. 1, 1893.

Employs a compound stopper inserted in the neck of the globe, one part tightly closing the neck and supporting the leading-in wires while another part hermetically seals the stopper and the wires.

Material for Making Electric Light Filaments, G. A. Cannot, London, Eng., 523,264. Filed Dec. 12, 1893.

Claim:

A filament for incandescent electric lamps, consisting of a thin yarn of peat fibre carbonized and treated in the ordinary way.

Incandescent Electric Lamp, J. E. Crigall, Springfield, Mass., 523,305. Filed June 11, 1894.

Employs a mount consisting of a single tube of glass containing the leading in wires embedded in a vitrified substance and a body of rubber cement.

Miscellaneous:—

Diaphragm for Electrolytic Cells, C. N. Waite, Rumford, Me., 523,026. Filed Aug. 12, 1893.

Employs a sheet of indestructible material against the negative electrode and an adjacent layer of sand against the sheet holding it against the electrode.

Process of and Apparatus for Electroplating, C. M. Barber, Cleveland, O., 523,090. Filed Jan. 5, 1893.

The invention consists essentially in automatically conducting the entire series of operation necessary for electroplating and in providing mechanism for feeding, conveying, plating, washing, drying and delivering the articles to be plated.

Apparatus for the Manufacture of Chlorin Monoxid, G. A. Cannot, London, Eng., 523,263. Filed Sept. 22, 1893.

Process of Manufacturing Hypochlorous Acid, G. A. Cannot, London, Eng., 523,263. Filed Sept. 22, 1893.

Railways and Appliances:—

Electric Railway Supply System, W. A. Butler, New York, 523,104. Filed Mch. 16, 1894.

Employs a sectional overhead conductor and an elongated current collector making contact with one section before leaving the other.

Conduit Electric Railway, C. D. Jenney, Indianapolis, Ind., 523,146. Filed Mch. 5, 1894.

Claim 5 follows:—

The combination, in a conduit electric railway system, of the conduit, the conductor rail located therein to one side of the centre of said conduit, and insulated arms supporting said rail from the sides of the conduit.

Supply System for Electric Railways, E. H. Johnson, New York and R. Lundell, Brooklyn, N. Y., 523,164. Filed Dec. 19, 1893.

A combined conduit and storage battery system.

Claim 3 follows:—

In an electric railway system a current feeder or main insulated throughout its length; working sectional trolley conductors provided with electromagnetic means for connecting them to the current feeder or main in sequence; a second set of sectional trolley conductors provided with circuit connections to said electro-magnetic means, in combination with a leak circuit between the two sets of trolley conductors. (See THE ELECTRICAL ENGINEER May 9, 1894.)

Supply System for Electric Railways, E. H. Johnson, New York and R. Lundell, Brooklyn, N. Y., 523,165. Filed Jan. 18, 1894.

Similar to No. 523,164.

Supply System for Electric Railways, E. H. Johnson, New York and R. Lundell, Brooklyn, N. Y., 523,166. Filed Feb. 10, 1894.

Similar to No. 523,165.

Electric Railway Crossing Insulator, H. B. Nichols and F. H. Lincoln, Philadelphia, Pa., 523,172. Filed May 9, 1894.

Conduit Electric Railway, J. W. Eisenhuth, San Francisco, Cal., 523,271. Filed Mch. 12, 1894.

Claim 6 follows:—

In an underground system for electric railways the combination of a conduit having an insulating partition and conducting wires on each side thereof and compensating joints introduced in said partition to allow of its expansion and contraction.

Electric Rail Bond, J. G. Hallas, Waterbury, Conn., 523,278. Filed May 1, 1894.

Consists of a body of uniform size having one or more coils to allow for expansion and contraction, and having ends adapted to be secured to the rails.

Bonding Joints for Electric Railways, A. L. Johnston, Richmond, Va., 523,284. Filed May 6, 1894.

A rail bond secured to the rails by thimbles and washers adapted to secure a perfectly tight joint.

Electric Railway, H. A. Doty, Janesville, Wis., 523,306. Filed Mch. 27, 1894.

Employs thin projecting lugs extending from the conducting wire, and contact shoes taking current from the lugs.

Electric Railway System, R. M. Hunter, Philadelphia, Pa., 523,318. Filed April 28, 1893.

A combined railway and lighting circuit in which arc or incandescent lights are placed either in the working conductors or in the return circuit.

Electric Conductor for Trolleys, J. W. Eisenhuth, San Francisco, Cal., 523,319. Filed June 21, 1893.

Claim 6 follows:—

An electric conductor for trolleys, etc., comprising a main conductor and a series of short tubular conductors surrounding the main conductor and having permanent electrical connection therewith.

Switches and Out-Outs:—

Electric Switch, J. F. Kester, Buffalo, N. Y., 523,074. Filed Nov. 23, 1893.

A double jack knife switch of special construction.

Telegraphs:—

Quadruplex Neutral Relay, C. D. Haskins, Brooklyn, N. Y., 523,119. Filed April 3, 1893.

Telephones and Apparatus:—

Telephone Transmitter, T. Grisinger, Mechanicsburg, Pa., 523,276. Filed May 24, 1894.

Employs a plunger independent of and out of contact with the granulated variable resistance but so arranged as to be capable of effecting the required changes in position of the particles of the variable medium.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JULY 24, 1894.

Accumulators:—

Secondary Battery, A. E. Peyrasson, Limoges, France, 523,371. Filed Nov. 1, 1893.

Employs a positive electrode of metallic laminae, soldered to a central metallic core and having capping discs of insulating material at the ends to prevent contact with the negative electrode.

Alarms and Signals:—

Block-Signal System, G. L. Thomas, Brooklyn, N. Y., 523,491. Filed Feb. 26, 1894.

An electric automatic block signal for steam railways.

Signal Telegraph, C. V. Boughton, Buffalo, N. Y., 523,617. Filed Nov. 13, 1893.

Consists of a number of lamps operated by keys, each key corresponding to a certain letter, and so connected with the lamps as to form a combination of dots and dashes representing that letter.

Distribution:—

Electrical Converter, R. H. Hamler, Dayton, Ohio, 523,572. Filed Aug. 4, 1893.

Consists of primary and secondary coils of approximately cylindrical form with the material comprising the magnetic circuit so applied as to almost completely utilize the space within the coil and to facilitate the radiation of heat from the circuit.

Dynamos and Motors:—

Controlling Mechanism for Electric Motors, C. H. Richardson, Philadelphia, Pa., 523,444. Filed April 26, 1891.

Provides means whereby the variable resistance, by means of which the speed of the motor is regulated, is carried by the support upon which is also mounted the actuating lever and the reversing and stopping contact.

Mode of Mounting Dynamos on Car Trucks, W. Biddle, Brooklyn, N. Y., 523,453. Filed Oct. 6, 1893.

Relates to an electric train lighting system in which the generator is flexibly mounted on the car axle.

Starting and Controlling Device for Electric Motors, J. W. Moore, Boston, Mass., 523,595. Filed April 25, 1894.

Relates especially to controllers for constant potential circuits operating elevators, etc.

Lamps and Apparatuses:—

Multiple Filament Lamp, A. L. Clough, Manchester, N. H., 523,395. Filed Aug. 2, 1893.

An incandescent lamp having the branching socket with a filament in each branch and independent terminals and switches.

Method of Working Arc Lamps, W. S. Horry, New York, N. Y., 523,401. Filed Oct. 17, 1893.

The method consists in causing the current to generate a secondary current by means of a transformer and permitting it to magnetize the core of the transformer to saturation so that the current through the lamp decreases as the voltage between the carbons increases.

Incandescent Electric Lamp, F. M. F. Casin, Hoboken, N. J., 523,460. Filed Dec. 7, 1892.

Claim 3 follows:—
An electric incandescent lamp in which the semi-conductive material intended and adapted to glow is closely, directly and hermetically embedded in non-conductive solid matter made of two parts, one part being opaque and the other mainly transparent.

Electric Incandescent Lamp, F. M. F. Casin, Hoboken, N. J., 523,461. Filed July 24, 1893.

Similar to No. 523,460.

Measurement:—

Electricity Counter, F. A. Brocq, Paris, France, 523,556. Filed Sept. 21, 1893.

Employs a vessel containing liquid and a float, the movement of which serves to record the intensity of the current to be measured.

Miscellaneous:—

Electrically Propelled Perambulator, E. E. Keller, Chicago, Ill., 523,354. Filed Apr. 20, 1892.

Electrical Igniting Device for Gas Engines, A. J. Painter, Dec'd., N. Painter, Administratrix, Pasadena, Cal., 523,360. Filed July 26, 1893.

Electric Snow Plow, L. J. Hirt, Somerville, Mass., 523,471. Filed Nov. 20, 1893.

Railways and Appliances:—

Electric Railway System, A. C. Crehore, Ithaca, N. Y., 523,396. Filed July 20, 1893.

The invention consists in part in a combination of circuits and devices involving a storage battery charged from a circuit on the car for operating the switch magnets and an auxiliary conductor over which the magnets are energized either by the battery or by the power current.

Trolley Catcher, E. M. Drummond, Louisville, Ky., 523,625. Filed Feb. 3, 1894.

Telephone and Apparatus:—

Telephone Switch, J. O. Ziegler, Boston, Mass., 523,618. Filed May 10, 1894.

Relates to special construction of the receiver hook.

Telephone, S. D. Field, Stockbridge, Mass., 523,630. Filed April 7, 1894.

Claim 1 follows:—
A compound telephone diaphragm formed of a plurality of constituent plates united at their centres, and separated or sprung apart at their edges the said edges being free to move radially.

REPORTS OF COMPANIES.

FORT WAYNE RECEIVERSHIP.

CIRCULARS were issued July 25, calling upon the minority stockholders of the Fort Wayne Electric Company to deposit their certificates for mutual protection with the State Street Safe Deposit and Trust Company, Boston; voting power to be lodged with Moses Williams and Frank A. Day of Boston, and Joseph N. Smith of Lynn. The call is issued by E. S. Converse, R. L. Day & Co., Charles Head & Co. of Boston; B. F. Spinney, A. B. Martin, and J. N. Smith of Lynn; J. H. Bass of Fort Wayne, and M. M. Belding of New York. The call is accompanied by the following circular:—

OUTLINES OF THE EVENTS LEADING TO THE RECEIVERSHIP OF THE FORT WAYNE COMPANY.

Prior to August, 1893, the Fort Wayne Electric Company was financed mainly through the General Electric Company. That company holds about 48 per cent. (42%) of the capital stock of the Fort Wayne Company, and a number of individ-

uals closely connected with the management of that company hold sufficient additional stock to give the General Electric Company a small majority.

The practice has been for the Fort Wayne Company to send to the General Electric Company the bills receivable, and stocks and bonds received from the customers, to be marketed by the General Electric Company; and the Fort Wayne Company drew upon the General Electric Company against the funds so created.

In August, 1893, when drafts drawn by and cashed for the Fort Wayne Company to the amount of \$120,000, were outstanding, the General Electric Company refused to honor these drafts and refused to furnish any financial aid to the Fort Wayne Company.

At that time the Fort Wayne Company had obligations outstanding under discount to the amount of \$1,500,000, which were maturing from time to time. The Fort Wayne Company had been divested of most of its cash by payment of its last dividend, in May, 1893. It could not, under the financial conditions then existing, market its stocks and bonds, except at a very great sacrifice, and even at a sacrifice could not effect sales sufficient to meet its obligations as they matured.

Under these circumstances, Mr. Ronald T. McDonald, of Fort Wayne, who had been connected with the management of the company since its start, and was a considerable stockholder, came to the aid of the company and supported it by using his own means and personal credit. For this purpose he incurred obligations in the nature of endorsements and guarantees for the benefit of the company, which amounted, on June 4, 1894, to over \$300,000, taking as security whatever the company had to offer in the shape of stocks and bonds of other companies, apparatus, materials, supplies and bills receivable.

This pledge to Mr. McDonald was not allowed by him to interfere with the carrying on of the business of the company, or with the sales of its stocks and bonds. The latter were marketed from time to time, as the company found favorable opportunity, and the proceeds applied to reducing the obligations of the company.

Mr. McDonald would have been willing to support the company in this way until better times if the attitude and action of the General Electric Co. had permitted. That company claims to be a creditor of the Fort Wayne Co. to the amount of \$1,000,000 and upwards. Its claims are disputed by Mr. McDonald and the officers of the Fort Wayne Co., who assert that the latter company is entitled to large credits and offsets which the General Electric Co. has refused to allow.

The Annual Meeting of the Fort Wayne Co. was fixed for the 9th day of June last, and shortly before that date the General Electric Co. announced that they proposed to elect their own men directors of the Fort Wayne Co., and to take control of its assets and business.

Besides the claim of the General Electric Co., the direct obligations of the Fort Wayne Co. on June 4 amounted to about \$500,000, and there were also indirect obligations to the amount of, in round numbers, about \$1,000,000. This last consisted of notes or other obligations received by the Fort Wayne Co. from its customers, endorsed by it and discounted.

These notes will, in many cases, have to be extended, but it is believed they will eventually be paid.

On the other hand, the Fort Wayne Co. has a large and valuable business extending throughout the United States. It has very valuable assets in the shape of stock and materials on hand, and bonds and other obligations of its customers. It has also by contract with the Thomson Houston Co., the right to use the factory and machinery at Fort Wayne for a period of fifteen years, of which only some four or five have expired. This contract is deemed an asset of considerable value. It seems plain that if the General Electric Co. came into control of the Fort Wayne Co., it would, in the first instance, endeavor to secure the payment of the debts which it claims to be due it from that company, and there would have been no one to dispute the validity or amount of the claim. Moreover, it was evidently the interest and the aim of that company to acquire for itself, through its control of the stock, the business and goodwill of the Fort Wayne Co., rather than to protect its stock or even its claims as a creditor. This had previously been manifested in efforts to restrict and circumscribe the business of the Fort Wayne Co. Under these circumstances, three days before the annual election, application was made by Mr. McDonald, to the Superior Court of Allen County, Indiana, for the appointment of receivers, and Messrs. Henry J. Miller and Edward J. Hathorne, were duly appointed and qualified on that day.

The receivers were ordered to make and file with the clerk of the court a full inventory of the property, and to file reports of their doings from time to time. They were authorized to continue the business of the company until otherwise directed by the Court, and to do everything necessary and requisite to realize the full value of the assets of the company for the benefit of creditors and stockholders. This was the scope and purpose of the receivership.

Certain other things were done which were deemed to be an aid to the receivership. A new and independent corporation was formed called the Fort Wayne Electric Corporation. This corporation has, by leave of the Court, made a contract with the receivers by which it agreed to furnish all labor and material for manufacturing and completing apparatus on hand, and to carry on the business at the Works in Fort Wayne, paying the receivers 20 per cent. on the cost of manufacture, and also a compensation of \$3,000 per month.

No assets of the old company except the office furniture in New York, Chicago and Pittsburgh have been sold or in any way transferred to the new corporation, but the latter will undertake the selling of apparatus on hand and the completion and sale of what is incomplete, and will continue to keep the market supplied with apparatus of the Fort Wayne Company, which is deemed essential to the prosperity of the local companies which the Fort Wayne Company has already supplied, and whose obligations constitute a large part of the company's assets.

As the apparatus in their hands is sold, the receivers will get the proceeds in cash. Every dollar's worth of assets can be traced from the inventory and as the receivers must account for each item, the creditors and stockholders are sure of receiving all that can be realized from the assets.

As soon as the receivership was announced, the General Electric Company attached what assets of the corporation it could lay its hands on in Massachusetts, New York, Maryland and Illinois, thus endeavoring, if possible, to secure for itself a preference over the other creditors. It also endeavored to carry out the proposed plan of electing a board of directors composed of its own officers and employees, but its attitude having been called to the attention of the Superior Court of Indiana, the Court issued a restraining order, prohibiting the holding of the annual meeting until the matter had been fully argued. This argument has been adjourned from time to time.

In view of these facts, stockholders of the Fort Wayne Company can determine whether the action taken on the appointment of receivers is calculated to benefit or prejudice their interests.

H. G. OLDS,
President Fort Wayne Electric Company.

PHILADELPHIA BASEBALL.—The opinion is current in this city that if the League team could only secure the services of some of Partrick & Carter's experts it would stand a good deal higher than it does in the lists and probably take the pennant. In one match recently played by the Partrick & Carter Co. team against the A. F. Moores, they made a score of 87 to 9. In another against Walker & Kepler's, they made 21 to 11. For the winners, Townsend's play was very good and effective. If there is any electrical baseball team in New York dying for a defeat, the P. & C.'s will be glad to let them have it on easy terms.

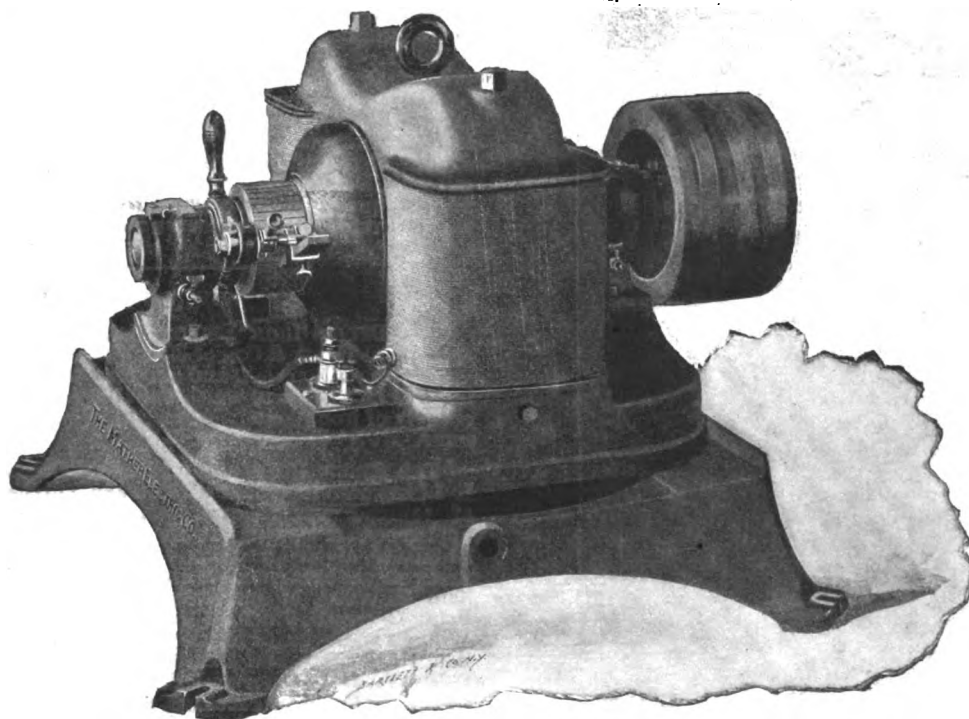
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE MANCHESTER TYPE SLOW SPEED MOTOR.

THE type of slow speed electric motor, shown in the accompanying illustration, will be seen to resemble in general design the well-known Manchester motor, manufactured by the Mather Electric Co., of Manchester, Conn., which has been used with so much success for years, both in this country and abroad. The electrical design and insulation are excellent; the motor is mechanically and magnetically symmetrical, and destructive sparking at the commutator, under all changes of load and conditions, is claimed to have been obviated.

The fields are of cast steel, while the base, sub-base, etc., are of cast iron, giving great lightness for any given power. The field coils are wound on metal bobbins, perfectly insulated, and can be slipped on and off the field magnet with great ease. The bearings are of an improved self-oiling type, with composition bushings, and, with proper care, will last indefinitely.



MANCHESTER TYPE SLOW SPEED MOTOR.

The armature, which is exceedingly large, is of the iron-clad slotted type, and of the modified Siemens winding, insuring slow speed. Great care is taken in building it up; the shaft, which is very large in diameter, is of the best machinery steel; the core is of sheet-iron discs, which, by an improved annealing process, together with a proper proportion of wire, does away entirely, it is claimed, with destructive heating. The insulation throughout is of the best obtainable, mica being used exclusively, and all armatures are carefully balanced before being sent out.

The commutator is of improved design, exceedingly massive, and carefully insulated. Pure Lake copper is used exclusively in building up these commutators, and the drop-forged bars, although much more expensive than those of cast copper, insure an absence of the blow holes and black spots in the bars, and a smooth running and long-lived commutator.

Every part of the Manchester type slow speed electric motor is made to jigs and templates, and can be duplicated at once from stock, without delay.

ROBINSON MACHINE CO.

THE ROBINSON MACHINE COMPANY, the leading industry at Bellwood, Blair county, Pa., manufacturing electric machinery, etc., has failed. Ira Wetzel and Charles Robinson have been appointed assignees. The company had a large force of employees on its pay roll. Philadelphia capitalists, it is said, are chiefly interested in the concern.

ELECTRICAL PORCELAIN GOODS.

ONE of the peculiar things about the electrical supply business is the remarkable suddenness with which a demand will sometimes spring up for an article which before has been scarcely known to the trade. A case in point recently has been the demand for porcelain tubes for insulating purposes, caused by the more strict insurance regulations. The demand for these goods is so large just at present that the factories have difficulty, it is said, in turning them out fast enough to meet the demand. The Electric Appliance Company, anticipating to some extent the present condition of the market in this respect, arranged some time ago to carry a very large stock of these goods, and are in shape at present to meet all demands. They have also just issued a complete catalogue of electrical porcelain goods, and are distributing it among the trade, and will be pleased to send it to any who have not been supplied.

SEBASTIAN LATHE CO.

THE Sebastian Lathe Co., of Cincinnati, Ohio, manufacturers of machinery, tools and general supplies, have issued a 48 page catalogue, profusely illustrated, in which their excellent machinery is

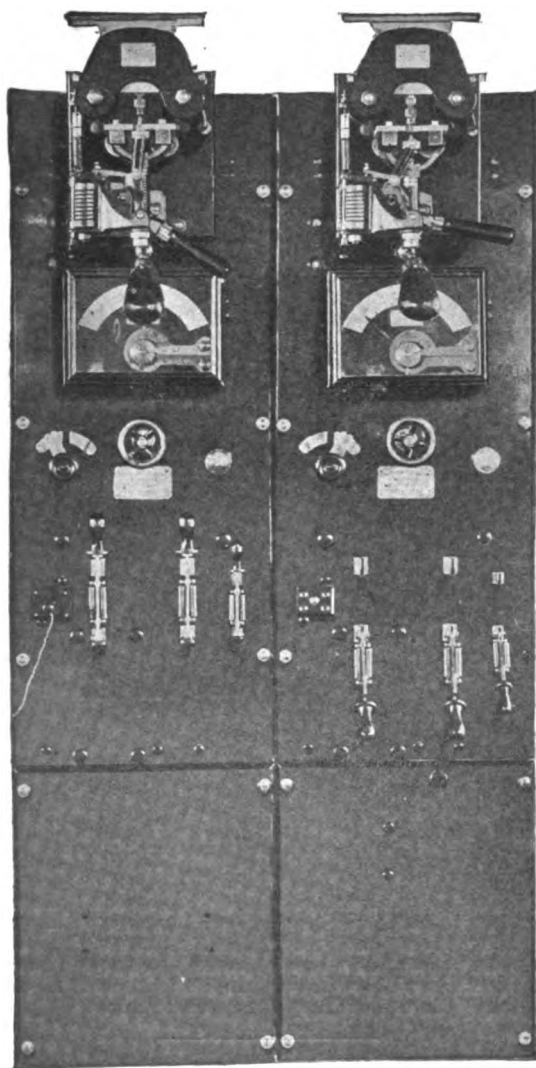
clearly described. The company's factory is equipped with the most approved tools, specially adapted to the work proposed. Skilled workmen are employed, and all work is subjected to careful inspection and actual operation before leaving the factory. A long list of testimonials bears witness to the esteem in which the company's apparatus is held by those who use it.

SUCCESS OF THE GARLOCK PACKING COMPANY.

In 1883, Mr. O. J. Garlock, whose occupation at that time was chief engineer for the firm of Bartle & Eames, invented a packing, and after many successful experiments, applied for, and was granted, letters patent for the United States and Canada. Being a practical engineer, he fully understood all that was wanted in the way of a packing for steam, water and ammonia. The business was begun in a small way without capital, and the continued increase made it necessary to secure facilities for properly conducting it. The members of the firm constituting the Garlock Packing Company at present, are: O. J. Garlock, E. Nicholas and F. W. Griffith; as organized in 1887. Since that time the business has developed with phenomenal rapidity. This company now manufacture their packing in Palmyra, N. Y., and Rome, Ga., and also have extensive offices and warerooms in New York, Philadelphia, Pittsburgh, St. Louis, Omaha and Chicago. It may be interesting to our readers to know that their business, notwithstanding the hard times, was nearly doubled in 1893, over the previous year. They are now making a new announcement in our advertising column.

GENERAL ELECTRIC RAILWAY GENERATOR SWITCHBOARD PANEL.

In order that the switchboards of electrical railway stations may be of uniform construction, handsome in appearance, and generally a credit to the station, some originality of design and treatment is necessary. We described a short time ago a feeder panel of the General Electric Company's make intended to fulfil electrical and æsthetic requirements combined, and we now show a generator panel made by the same company. Briefly, the system of switchboard construction while becoming greatly simplified, is rendered very compact and convenient. All the instruments necessary for the control of each generator are mounted together on an incombustible base and are electrically connected before leaving the factory. Each panel may be erected in position without difficulty or delay. Being of uniform size it may be bolted alongside other panels already in place, and the switchboard extended as the capacity of the station increases without taking away from its uniformity.



GENERAL ELECTRIC RAILWAY GENERATOR SWITCHBOARD PANEL.

These new standard panels are known as type "K" and are constructed in capacities of from 200 to 3,000 amperes corresponding to the generator outputs of from 100 to 1,500 kilowatts. The controlling devices mounted upon each panel are the circuit breaker, current indicator, rheostat, main, field and lighting switches, together with the lightning arrester and cut-outs required for the protection of generator and instruments. A double pole plug switch allows of connection with either a portable or station voltmeter placed in some convenient position. The panels of from 200 to 1,000 ampere capacity are of the same width and height, and, in the latter dimension are similar to the feeder panel. The illustration shows two panels of 400 amperes each.

The automatic circuit breaker is intended to relieve the generator of the severe strain caused by short circuit. The tripping armature is fitted with an adjustable spring whereby the circuit breaker can be set to open at any desired point within the range of the instrument. The current is nominally carried through a

main contact in shunt to a contact operating within a magnetic blow-out. Thus when operating, no arc occurs at the main contact. This circuit breaker will effectually rupture any short circuit however severe. The armature is provided with a scale 18 inches long which may easily be read at a distance. The positive and negative main switches and the station lighting switch, all of the quick break type, are mounted on the panel, the equalizing switch being mounted on a pedestal near the generators. In the lightning arrester the special feature is an ironclad electric magnet in the field of which are two carbon points slightly separated, the line and ground each being connected to one of these points. The magnet is on the blow-out principle as in the automatic circuit breaker. The incombustible controlling rheostat is placed behind the board and is operated by a hand wheel shown on the front. The generator terminals are connected by a small four-point plug switch with an illuminated dial voltmeter mounted on an adjustable bracket fastened near the top of the panel.

The panels are supported by vertical angle irons, tie rods and brackets. They are wired complete, and after setting in place it is only necessary to connect the leads from the generators, and bolt in place the bus bars which run horizontally back of the switchboard.

PHILADELPHIA NOTES.

MESSRS. F. E. BAILEY & Co., Betz Building, report the following sales of Eureka Oil Purifiers, that they have recently made:—Messrs. W. R. Fleming & Co., New York and Boston; Bausch & Lomb Optical Co., Rochester, N. Y.; Portland Hotel, Washington, D. C.; Newton Electric Light and Power Co., Newton, Pa.; Oneida Electric Light and Power Co., Oneida, N. Y.; Cerealine Manufacturing Co. (3 bbl.), Indianapolis, Ind.; Messrs. C. R. Rumpp & Sons, New Building, Philadelphia, Pa.; Bavaria Brewery, Wilmington, Del.; Germania Park and Steamboat Co., Philadelphia, Pa.; Sauquoit Silk Manufacturing Co., Scranton, Pa. They have also just received orders for a number of machines for Cuba and elsewhere.

NEW YORK NOTES.

THE BERLIN IRON BRIDGE CO., have received the contract from M. C. Henry & Co., of New York, N. Y., to cover their stone yard with an iron roof, and also for a travelling crane. The building will be 50 feet in width and 100 feet in length, constructed entirely of iron, the whole space to be controlled by the travelling crane.

THE KINGS, QUEENS AND SUFFOLK COMPANY, of Brookhaven, L. I., has been incorporated to make, purchase and sell all kinds of railroad supplies and equipments, dynamos and electrical appliances, rails, ties, trestle work, etc. The capital stock is \$1,600,000, divided into shares of \$25 each. The directors for the first year are Frederick W. Dunton, John N. Williamson and William L. Wood, of Jamaica; George E. Hagerman, of Rocky Point; George B. Finch, of Brooklyn; Henry C. Rath, of Flushing; William L. Burke, of Brooklyn; Isaac M. Kellogg, of Hollis; William H. Boynton and Detlef C. Reusch, of Jersey City; Roman Debes, Frank L. Ryan and Peter D. Sturges, of New York City. George B. Finch, of Brooklyn, subscribes for the bulk of the stock \$63,900. The parties interested are connected with the Boynton bicycle railway system.

WESTERN NOTES.

THE ARNOLD TELEPHONE CO., Chicago, has been incorporated with a capital stock of \$1,000 by Sam. S. Arnold, M. F. March and Wm. Howell.

THE PONTIAC TELEPHONE CO., Pontiac, Ill., capital stock, \$8,000, has been incorporated by D. S. Myers, John S. Murphy, Henry A. Foster and others.

MR. EDWARD B. WYMAN, Manager of the Central Electric Heating Co., New York, is in Chicago looking after some business matters for his company.

THE KNAPP ELECTRICAL WORKS, Chicago, have issued their new "Illustrated General Catalogue," which is one of the finest productions of the kind issued for some time past. Within its pages can be found every article used in electric lighting, power or street railway plants, as well as a complete list of telegraph, telephone and house goods supplies. Each article is illustrated and has a trade word. The book is a handsome 8vo. volume of 417 pages, printed on a high grade of enamelled paper and reflects much credit on the liberal and progressive house that issued it.

Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.

Vol. XVIII.

AUGUST 8, 1894.

No. 327.

THE TREATMENT OF DRINKING WATER, SEWAGE,
GARBAGE AND DISEASES BY ELECTROZONE.

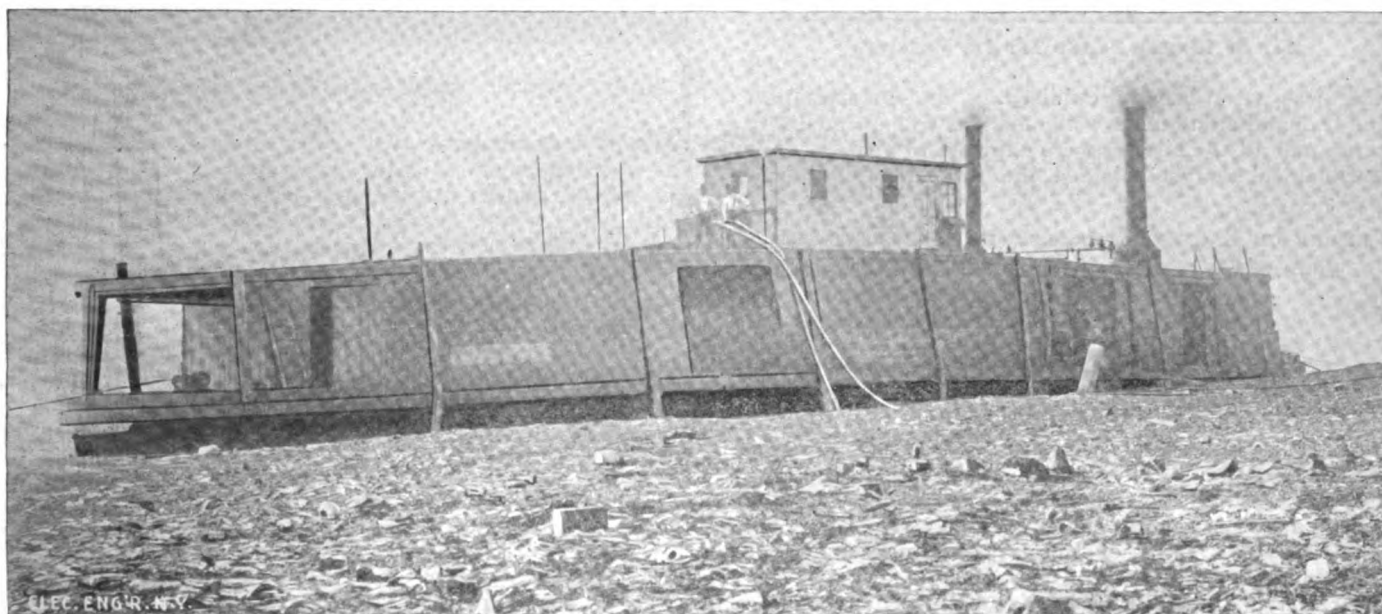
BY

T. C. Martin

I.

JUST a year ago the attention of the public of New York City was arrested by the bad condition of the drinking water, and by the attempts made to purify it. The horrible experience of Hamburg with cholera had shown that a severe epidemic could very quickly be created by bad water, and while elaborate instructions were issued as to

current of 4 or 5 volts and several hundred amperes and passing it through a platinum-zinc couple immersed in a large vat through which the water was in constant flow, Mr. Woolf readily obtained his electrozone in correspondingly large quantities. The electro-chemical action, broadly stated, was that of converting the sea water chlorides, bromides, etc., into hypochlorites and hypobromites; and such solutions of sodium had very little mercy for organic matter with which they might be brought in contact. One portion of the chlorine in the hypochlorite replaced part or all of the hydrogen in the organic matter; and another part pounced on the liberated hydrogen, and ozone was produced, which in turn had its due effect on the organic matter. In other words, the process is at once that of perfect decomposition and disinfection, sterilizing polluted water or purifying decayed or dead organic substances. The knowledge as to this effect of chlorine was not altogether new,



WOOLF ELECTROZONE DISINFECTING BARGE AT RIKER'S ISLAND, FOR THE TREATMENT OF GARBAGE.

boiling the water, etc., it was seen that the better way was, if possible, to deliver the water pure, and to sterilize any sewage that might find its way into the supply. Hence it came about that at Brewster's, N. Y., whose sewage drained into a marsh from which part of the New York City water supply was derived, a determined effort was made to render the pollution innocuous. The New York City medical authorities with Dr. Cyrus Edson at their head, agitated the subject, but did not find many persons willing to grapple with the problem on the rough and ready, yet adequate, plan necessary to successful dealing with city drinking water, in such huge volume. At this juncture, Mr. Albert E. Woolf, who had already made some interesting inventions in electricity, offered to undertake the task with a purifying liquid which he called electrozone, and which he obtained by the electrolytic treatment of sea water or salt water. Taking a dynamo

but Mr. Woolf was the first to produce the disinfectant he dubbed "electrozone," and to give it to the public as something of the utmost value in all sanitation.

Be this as it may, the fact is familiar to the readers of THE ELECTRICAL ENGINEER¹, that Mr. Woolf last summer afforded a very striking demonstration at Brewster's of what electrozone could do, proving to every impartial and disinterested observer that electricity in this way could become a mighty agency for the purification of water, the prevention of zymotic diseases, the disinfection of sewage, the sterilization of garbage, and for other sanitary work. It may be mentioned here that, with the help of a small plant, electrozone was sprayed into Tonnietta Brook, near Brewster's, at the rate of about 1 part of the contained hypochlorite to 100,000 parts of water. The results of

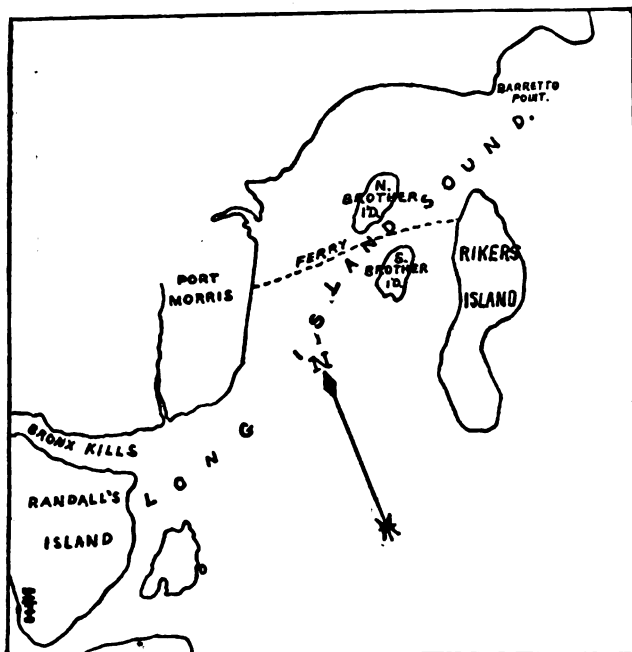
1. The work at Brewster's was very fully illustrated and described in THE ELECTRICAL ENGINEER, July 19, 1893, Vol. XVI., No. 272, page 53, et seq.

this treatment were reported to Commissioner Edson last September, by Dr. E. A. Martin, chemist of the Health Department, in a careful discussion of the whole subject, from both the chemical and the bacteriological standpoints. He stated that after the treatment, the nitrogeous organic

bring down the percentages still further, the rates were only 1.75 and 0.20.

II.

In view of the above facts, we need hardly wonder that Dr. Edson spoke of the new electro-disinfectant as "one of the greatest discoveries from a sanitary standpoint ever made." It was either this or a great, big humbug. There could be no question that if Mr. Woolf had hit upon an agent so powerful as that described, he had entitled himself to a high place in the ranks of great electrical inventors, for it was evident that its uses would be many and various. But it required a colossal nerve to undertake the next Augean task that Mr. Woolf tackled,—none other than the disinfection of Riker's Island. This recent addition to New York's pleasure resorts is situated in the East River and is the outermost of the islands and clumps of rock that the authorities have reclaimed and utilized as sites for prisons, asylums, hospitals, etc. It lies north-easterly from Port Morris about three quarters of a mile, and a little south of Westchester county. It was bought by the city about two years ago and is about 137 acres in normal extent. At the southern end of this island and projecting out toward the channel frequented by Sound-going craft



MAP OF RIKER'S ISLAND AND ITS VICINITY.

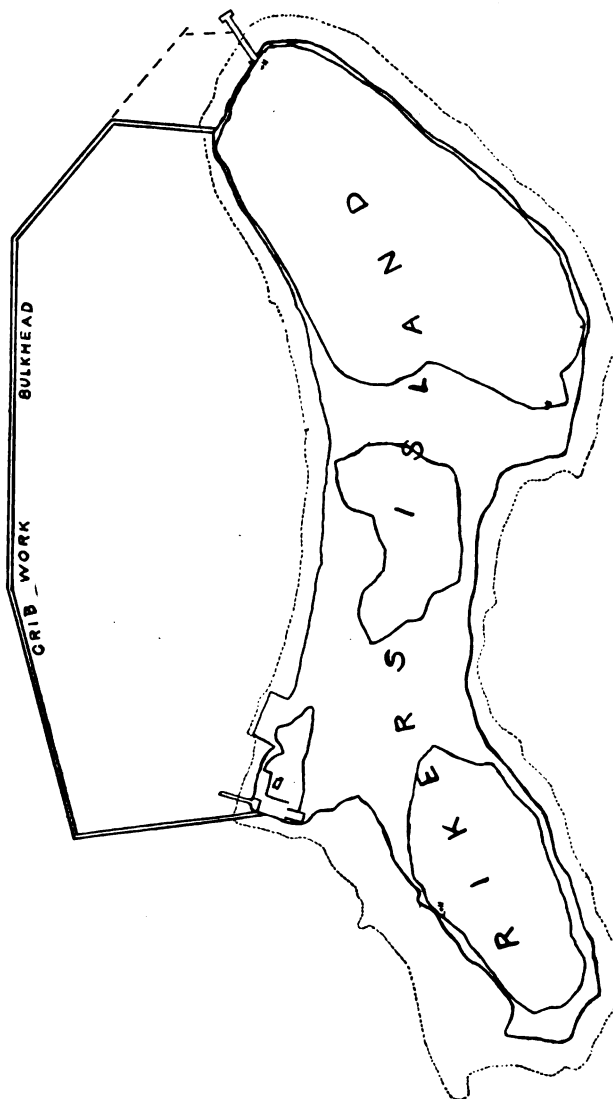
matter was very largely oxidized. The greater part of the free and albuminous ammonia was transformed into nitrates, and all the nitrites were oxidized to nitrates. The bacteriological analysis yielded the following significant figures:—

NUMBER OF BACTERIA PER C. C. IN SAMPLES TAKEN.

<i>Before Treatment.</i>	<i>After Treatment.</i>
32,600	8
22,000	42
2,353	12
4,134	0
7,000	0

Dr. Martin was so impressed with these figures that he requested that they be checked and verified by a bacteriological specialist. He also made a test of Brewster's sewage treated by the electric current, and Woolf electrozonic method, and by a series of 15 minutes tests found that sewage which contained about 10,000,000 bacteria per c. c. was perfectly sterile after an hour and thirty minutes.

Since that time the sewage of Brewster's has been steadily treated by the Woolf process, and Dr. J. G. Wood, the local Health Officer, reports that the village itself has never before been in such a healthful condition, adding: "I have frequently visited the dikes into which the sewerage empties under treatment with the electrical disinfectant, and have always found them to be deodorized and disinfected and in a condition positively not detrimental to health." Death had visited the Doctor's own family in one of the typhoid epidemics to which Brewster's had been liable, but he bears witness that since the use of the process, scarlet fever and malarial fevers have all been checked. This may explain the fact that in New York City the death rates from diarrhoeal diseases and typhoid fever have markedly fallen off since Brewster's was thus cleansed; and the inference is a fair one that electricity has been one prime agent in effecting this better condition of affairs. The average death rates from these diseases in the ten years prior to 1893 were 2.18 and 0.26, whereas for 1893, in spite of the increased population, which would



RIKER'S ISLAND SHOWING LOWLANDS AND CRIBWORK.

was constructed a strong cribwork of piles and broken stone, so that a vast inner space was gained from the water, to be filled in. Last Christmas, as a happy and fitting time, the Street Cleaning Department began to dump garbage there, it being evidently much more handy and convenient to do so than to tow the stuff out into the bleak



PLAYING ELECTROZONE UPON RIKER'S ISLAND GARBAGE.

and stormy Atlantic. Now, it is estimated that New York furnishes over 8,000 cubic yards of choice garbage every day, in the following proportions: ashes, 30 per cent; paper, 20 per cent; street sweepings, 20 per cent; kitchen refuse, 20 per cent; wood, 10 per cent. A large part of the garbage continued to go thither, so that by midsummer, over 1,000,000 cubic yards had accumulated within the cribwork. While the days were cold, this was a matter of indifference to the neighborhood, but by May and June, the whole mass was in a condition that might well be called infernal; in fact, fermentation went so far that at many points, smoke curled up, and an egg could be cooked anywhere, a few inches down. The stench was awful. I have been informed that it was nauseating three miles away, on the open waters of the Sound; while residents at College Point, nearly two miles off, and elsewhere, became loud in their outcry. At last the dumping of the garbage was stopped, but not before Mr. Woolf with a serene confidence in his ability to abate the nuisance came forward and offered to disinfect the whole island over whose artificial southern shore some 30 acres of vile refuse now lay massed to a height of 10 or 12 feet, with here and there a

pool of intensely black sludge, the odor of which was a concentration of all the bad smells the world has known. Mr. Woolf stepped in none too soon, for the island would ere long have heaved itself bodily out of its crib or have given birth to monsters equal in deadliness and vileness to any that the primeval slime ever saw.

III.

The task of reducing Riker's Island to a sanitary condition began on June 29 last, when, urged forward by the anxious authorities, Mr. Woolf ran alongside the crib a barge on which he had installed a modest electrozone plant capable of delivering about 4,000 gallons per hour of that liquid. All around, the river waters were black and noxious, the tides doing little to improve things; but Mr. Woolf, imitating the Bismarckian policy of frying Paris in its own fat, took that water into his tanks to be purified and showered back on the stinking, smoking, fermenting mass from which it slowly oozed. The illustrations herewith give a good idea of the island and of the little attacking barge. The plant, which will continue in operation for some time, consists of two Erie City boilers of a total 100 h. p., 2 Payne engines of 35 h. p. each, a surface condenser of 700 feet surface, a delivery pump of 10 h. p., a distributing pump of 15 h. p. and two Excelsior plating dynamos of 1,000 amperes capacity at 12 to 13 volts each. The dynamos are connected to 4 vats in series, each vat receiving 1,000 amperes at 5 to 6 volts, and each being of 500 gallons capacity. In each of these vats is placed a zinc-platinum couple composed of 5 zincs and 4 platins. The zincs are an inch thick and are 12 by 12 inches, weighing 40 pounds. The platinum electrodes weigh from 12 to 15 pounds, are 12 by 15 inches, and have a copper core with a platinum coating of .003 inch thickness. The wear is practically insignificant. By these elements the sea water pumped into the vats is rapidly electrolyzed and is then pumped out to the island, where it is received by the different lines of hose playing upon the garbage. The plant is now running 24 hours a day, 7 days in the week, and its use is paid for at the rate of \$128 per daylight run and \$65 per night run. It is to be superseded by a permanent plant, now being erected, of from 4,000 to 6,000 gallons capacity, which will not only take care of the garbage in situ but will promptly reduce to innocuity all other garbage brought to the place.

IV.

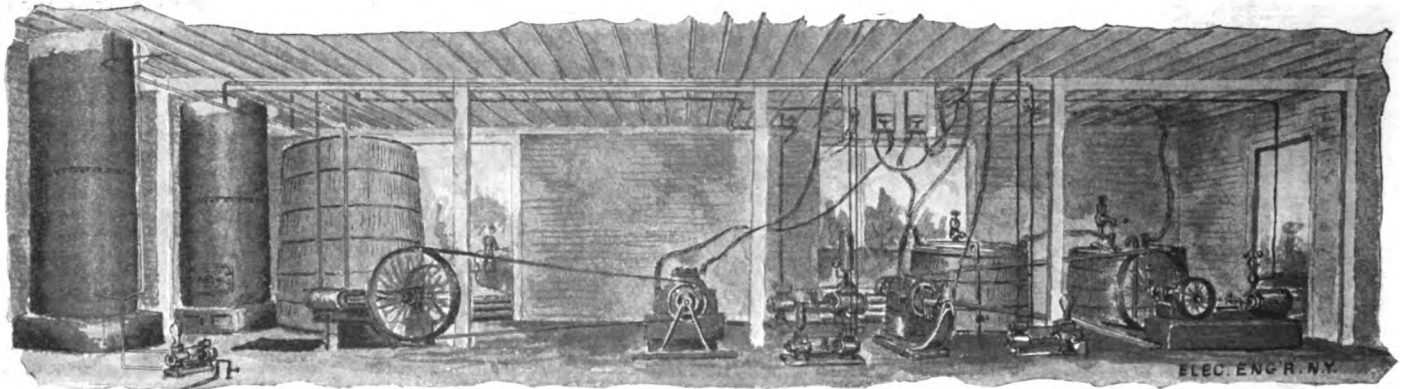
My attention being caught by the publication of the complaints from citizens in the Twenty-third and Twenty-fourth Wards, I called on Mr. Woolf a few weeks ago and asked him whether his plant was at work and whether it had accomplished anything. He invited me immediately to go and see, or smell, for myself, and as I betrayed some reluctance to undergo the ordeal he pledged his word that I would be most agreeably disappointed. I therefore accompanied him on July 26, going in the morning so as to find the Island at low tide, with all its wickedness



RIKER'S ISLAND, SHOWING CRIBWORK, INTERIOR POOLS, AND PART OF THE DUMPED GARBAGE.

bare, and with all its potentiality of smell fully developed by a sun which during July went over 90° no fewer than 18 days of the month. There also happened to be an easterly wind, so that standing on the cribwork or approaching the Island from the New York shore, one could enjoy the full benefit of the effluvia of the whole rotten

nauseated, but I found those on the barge and on the crib as busy and nonchalant as possible; while another gang at the upper end placing a thin face of earth on some of the garbage, were equally unconcerned and indifferent. They were all quite as eager as myself for a hearty lunch at noon-time. Moreover, I saw some twenty or thirty excursion



INTERIOR OF BARGE PLANT.

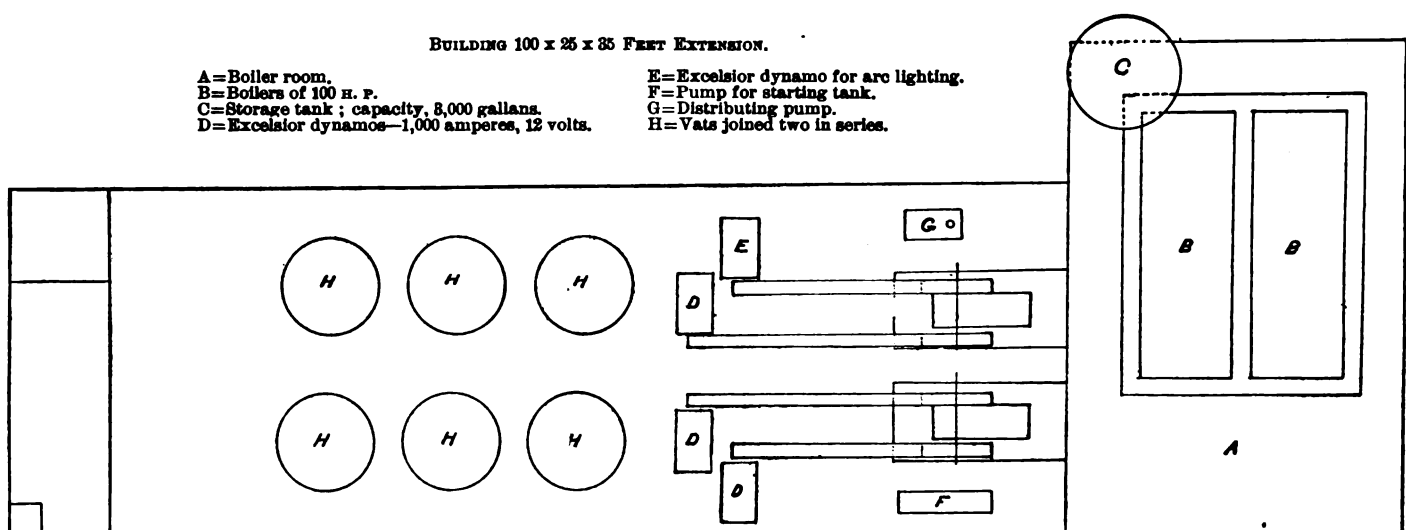
mass. Under such conditions, I may state that it was not until we arrived within one or two hundred feet of the Island that any odor was perceptible, and that only on one face, due, apparently, to the seepage of part of the falling tide through the lowest strata of the mass still untreated by disinfectant. The odor was strongly that of sulphuretted hydrogen and was certainly highly undesirable as a part of human nature's daily atmosphere. Landed on the Island, however, I found the smell there anything but pungent, and the sober truth of this statement may be inferred from the fact that I spent more than two hours right on the garbage walking about wherever it was firm under foot, and watching closely the half-dozen men who were playing on it with hose, just in the same way as the remains of a great fire are played on. Four thousand gallons per hour seemed a good deal of liquid, but when divided into six or

boats and barges go by. Until recently, the arrival of such craft off Riker's was the signal for an outburst on board of them of derisive groans and curses and for a general bad quarter of an hour; but now I saw the ships go by without the slightest cessation of the singing and dancing aboard, and without giving the slightest indication that the Island existed. Yet the brisk morning breeze was right towards them from the vast mounds of garbage on which our party stood. Later on I went over to North Brothers Island, about one-eighth of a mile away, and interviewed Dr. S. Dana Hubbard, Jr., the courteous medical superintendent. The wind was then setting directly over us from Riker's, but although we walked all around North Brothers, no smell was observable anywhere. Dr. Hubbard informed me that the change accomplished in this respect in a few weeks was very remarkable. He also told

BUILDING 100 x 25 x 35 FEET EXTENSION.

A=Boiler room.
B=Boilers of 100 H. P.
C=Storage tank; capacity, 8,000 gallons.
D=Excelsior dynamo—1,000 amperes, 12 volts.

E=Excelsior dynamo for arc lighting.
F=Pump for starting tank.
G=Distributing pump.
H=Valves joined two in series.



PLAN OF PERMANENT PLANT TO BE ERECTED.

seven streams, hundreds of feet apart, it gave the impression of a very small quantity, as related to the mass there to be brought under subjection. Yet, if the test of eye and nose goes for anything, electrozone has wrought wonders at Riker's Island. I am told that when men went there under the old conditions, they were frequently

me that before electrozone was used they had found it impossible on North Brothers to keep metal clean, and the brass work on the "Franklin Edson" steam tender was always turning black. I saw for myself afterwards that there was now no trouble in keeping it bright and shiny, man-of-war fashion.



UNLOADING A SCOW AT RIKER'S ISLAND.

V.

I would not be misunderstood, however, as to just what I found; and I think that the mere literal, unvarnished statement of the facts is enough to show that some remarkable work has been done. Odor there still was when I visited the Island, and it was evident that Mr. Woolf had considerable work cut out; but if he has not regenerated the place by Fall I shall be greatly mistaken. As far as I could determine, the electrozone had done its duty down to a depth of at least two feet. I had the ground dug up in forty or fifty places with a fork, and at that depth the garbage was almost invariably deodorized. Below that, the liquid had not yet penetrated except in a few places, but a change is being made in the treatment. Now that the surface is purified, deep holes are being dug and into these the electrozone is poured, so that it will soak and permeate in every direction and thus reach the underlying strata otherwise difficult to get at. But there was no question of the fact that over the surface of the whole thirty acres, in a brief three weeks, with his half-dozen little squirts, Mr. Woolf had brought death to every foul germ, gas and odor; and that the work of purifying infiltration is steadily and successfully going on. A curious feature about the garbage that I had the honor of interviewing closely with my nose was that so far from being putrid or stale it had the look of being touched by a light white frost, and often its breath was that which comes from a damp, cool, empty cellar—an earthy flavor that would indicate anything but organic decomposition. This bleaching effect need not surprise us in view of the abundant creation of ozone.

Another feature of the work that impressed me was the extraordinarily quick action of the liquid on the stagnant, stygian pools that had formed inside the crib, beyond the lines of dumping. To these marshes the tide could penetrate, but its ebb simply sucked so much black filth out of

the rotting mounds, to lie effervescing under the fierce sun; and the pools thus formed were the least sweet portion of the island. But, nothing daunted, Mr. Woolf has sluiced them with electrozone, and most of them are already harmless. I saw one such pocket of recent formation treated in this manner. It had been dammed across, and had become oozy, and the smell was very bad. Mr. Woolf first sampled it for us in several of the broken cups and saucers that lay around like sea shells for multitude, so that we had no doubt as to its virulence; and we could see it all a-bubble with sulphuretted hydrogen. A line of hose was then run out to the place and in a few seconds the evil-looking scum had gone for ever. In ten or fifteen minutes the vile odor was sensibly diminished, and probably by this time that pool, in the very heart of the grim island, is infinitely sweeter than the ordinary city sewers, and certainly far easier to live alongside than such a cloaca as that at West Forty-second Street or others further uptown.

VI.

The Island has, I understand, accommodations still for some 10,000,000 cubic yards of garbage. Whether it will receive that quantity or not I do not know. The complaints from the sea front of New York as to garbage floating around are likely to put a decided check on further dumping there except with heavy boats that can go right out for miles; and even then it seems a pity to throw away that which has made the fortune of many a "Golden Dustman." The use of destructors is being freely discussed, and frequent reference is made to their successful use in Europe. Such plans require costly apparatus of great capacity, and the same is true of the plan tried at St. Louis and some other places of treating the garbage with steam under high pressure, and with naphtha; or in kindred ways. One cannot but wish success to all such efforts, but it does seem that the miraculous work done by electrozone suggests a further and larger application of it in garbage disposal. There are 17 garbage dumps in New York city, and I don't quite see why the garbage should not be electrozoned there as well as, or instead of, at its place of final deposit. None of these dumps is a bed of violets but with the garbage thus treated as quickly as it arrives from the streets, a nuisance would be abated, and the scows on their way later to the final repositories would attract as little notice as if they carried bricks or lumber.

I am glad to quote in support of my own statements as to what I found at Riker's Island, the testimony of Dr. A. L. Metz, chemist of the city of New Orleans and of the Louisiana State Board of Health. After his visit to the Island, he said: "In every instance I found it completely disinfected; there was no active putrefaction going



"CAPE DESOLATION," RIKER'S ISLAND.

on, and, as a consequence, the noxious gases and odors so much complained of were not perceptible on the grounds."

Before passing on to touch upon one or two other remarkable uses of electrozone, I should make my acknowledgement to Dr. Hubbard, for his great kindness in taking, at my request, the photographs from which the illustrations of Riker's Island here used were made.

VII.

Since my visit to Riker's Island, Mr. Woolf has laid before me a mass of letters from medical men in all parts of this country, recounting their experiences in the use of electrozone upon so wide a range of diseases that one begins to wonder if there is any ill under the sun that electrozone will not cure or mitigate. The space at my disposal is necessarily limited, but if I had it I could fill scores of pages with data of this nature. A few instances must suffice. In these choleraic days, the testimony from Swinburne Island deserves first place. Mr. I. F. Kingsley, head nurse there, reports that in 30 cases last year 20 were treated with electrozone. Only one died, "and in that one case, the death was due to complications

inhibiting effect on anthrax spores and staphylococcus pyogenus aureus. Dr. Charles F. Roberts who tried it on a case of carbuncle never saw such rapid healing in his life; and he has been instrumental lately in beginning a test of it on cancer. Dr. Charles H. Knight writes that many of his patients are "clamoring for electrozone" and that he has seen some very striking effects in deodorizing and checking discharges of pus from various regions. Dr. Solis Cohen contributes a series of striking statements as to its beneficial use among tuberculous patients and in the Home of Consumptives, at Philadelphia. Dr. A. H. Briggs speaks of its very good results in treatment of scarlet fever, and says: "I am satisfied that in electrozone we have got a *reliable* and *safe* germ destroyer." Even the brute creation is benefited. Dr. Johnson, of the New York Veterinary Institution, has used electrozone in the cure of horse mange, and Mr. James S. Cattanch, V. S., of the Fifth Avenue Veterinary Institute, speaks of its effect as "marvelous" in the treatment of abscesses produced by blood poisoning; while Dr. Paul Gibier, of the Pasteur Institute, has applied it to the disinfection of the animal room at the laboratory. It is needless to go any further,



PLAYING ELECTROZONE INTO THE "SEA OF DEATH," RIKER'S ISLAND.

of kidney and lung troubles" The deaths from cases not so treated we all remember, but the spirillum that can stand up before electrozone has apparently to be rather tough. The Willard Parker Hospital reports as follows:—"The electrozone treatment of true diphtheria has been equally successful as any other * * * and the results in these seven cases have been fully as good as those from the use of the solution of bi-chloride of mercury, without the danger from the use of that drug." Dr. Stephen S. Burt speaks in similar language. Dr. P. S. Wales, medical director, U. S. N., reports from the Naval Bureau of Medicine and Surgery that electrozone was tested with putrid urine and found to be both a germicide and deodorant. Dr. P. D. Keyser, of Philadelphia communicates to the *American Therapist*, the report of several successful treatments, one being nothing less than a bad slough of the cornea; and he says he regards it as an excellent remedy in all cases of suppuration and in various forms of skin diseases arising from a micro-organism, while its non-poisonous character invites to freedom of experimentation. Dr. Cyrus Edson states that the liquid produces a marked

except to express the hope that more thorough investigation even than this will be made as to the value of such an agent. It might not be a bad idea, for example, to wash down the streets of plague-stricken Canton and St. Petersburg with it.

VIII.

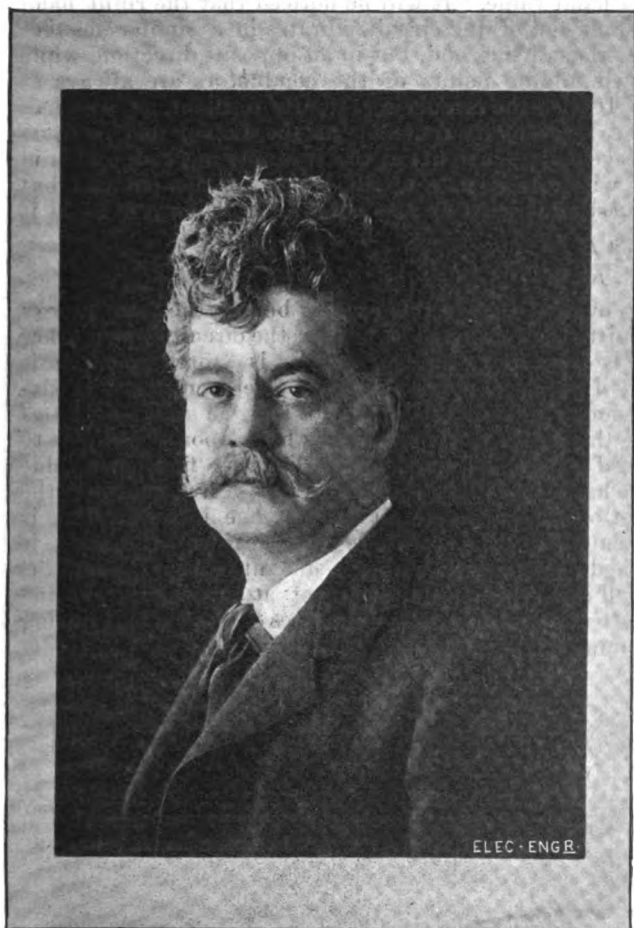
Incidental reference was made above to the bleaching effect of electrozone, and it is interesting to learn that this is being taken advantage of in the treatment of wood pulp for paper, a very large and important branch of industry. The process, as already developed, is said to effect a noteworthy saving in prime cost and in economy of material treated. The developments in this direction will deserve close study.

It is amusing to turn over Mr. Woolf's correspondence and batches of newspaper clippings, and note the various little tasks offered him or proposed for his handling. These schemes range from the purification of the Chicago River and the Hamburg Canal, at Buffalo, to the disinfection of the sewerage of The Hague, the royal city of Holland, and the purification of the old English town of Coventry, a work in which the Earl of Warwick is deeply

interested. Besides these, it would appear from the daily papers of various States that nearly every city in the Union has a pet little piece of nastiness awaiting annihilation at Mr. Woolf's hands. Some of these ideas are wild and grotesque, and exaggerate, as popular impressions always do, the ability of an inventor and his work, but they mark a hopeful and desirable enmity of the public mind toward filth in whatever form. I take it for granted there are "politics" in some of these proposals, but that is an inevitable result of municipal management and municipal ownership. The work could most probably be better done by private hands, but even if done by municipalities it is well done if it be done at all. We are that much safer.

IX.

I may be forgiven if in thus epitomizing what Mr. Woolf has aimed at and has already done, I ven-



ALBERT E. WOOLF.

ture to add a few biographical sentences. He is the son of Edward Woolf, well-known to many an old New Yorker as artist, litterateur and musician, and among newspaper men as the founder of *Judy*, the first of the modern illustrated comic papers here. One of the sons of that versatile genius is Mr. Benjamin Woolf, of Boston, author of "The Mighty Dollar"; another is M. A. Woolf, the artist and caricaturist; and a third is Prof. Solomon Woolf, instructor in mathematics at the College of the City of New York. Mr. A. E. Woolf, the fourth son, and the inventor of electrozone, has for many years been an enthusiastic student of electricity, and some of his work has already been described in these pages. It has been chiefly in electro-chemical fields, and to his investigations may be attributed both his storage battery and the now well-known dégradé-bleaching process by peroxide of hydrogen,

by which he made and lost a fortune in feathers. Aside from his work as electrician and chemist, however, Mr. Woolf has a very pretty talent as sculptor, the most popular and celebrated of his productions being a vigorous and faithful bas-relief of General Grant, highly commended by Generals Logan, Barnum, Shaler and others. During the past year, New York newspapers have perhaps been busier with Mr. Woolf's name and work than that of almost any other electrical inventor, and if the results of better sanitation now in sight are reached, he will achieve a reputation that is at once well deserved and world wide. The portrait here shown is by Parkinson.

THE RESONANCE OF ELECTRICAL CIRCUITS.

BY

H. W. Dunsen

As the practical bearing of resonance upon the transmission of power has received adverse criticism at the hands of Prof. Anthony and the editors of 'THE ELECTRICAL ENGINEER,' I feel justified in continuing my defense of the subject and will attempt to meet the criticisms which have been made against its practical utility. As to the fact that resonance is possible upon long distance circuits, and as to the conditions which will bring such a circuit into resonance there seems to be but little difference of opinion, but as to the conditions which exist upon such a circuit, Prof. Anthony differs very materially from the mathematical results which I have obtained in the articles to which he refers. If we grant, as Prof. Anthony states, that the value of the current which will result when the line is in resonance is that furnished by Ohm's law $\left(\frac{E}{R}\right)$ and that

the receiving instruments at the distant end of the line will necessarily throw the line out of resonance if considerable power is to be transmitted, then the advantage of a decreased loss in transmission due to the smaller i^2R loss of a resonant circuit might be to a very great extent offset by the increased dielectric strain which would occur at certain points of the circuit, and which Prof. Anthony considers very objectionable.

But Prof. Anthony has only assumed and not attempted to prove that the value of the current is not greater than $\frac{E}{R}$ when the circuit is tuned to the rate impressed upon it, nor has he shown that it is impossible to place receiving apparatuses at the distant end of the line which are capable of absorbing a large fraction of the energy transmitted without destroying the conditions of resonance. Although at first thought it might appear contrary to the law of the conservation of energy that a current will result at the distant end of a resonant circuit greater than $\frac{E}{R}$, I wish to

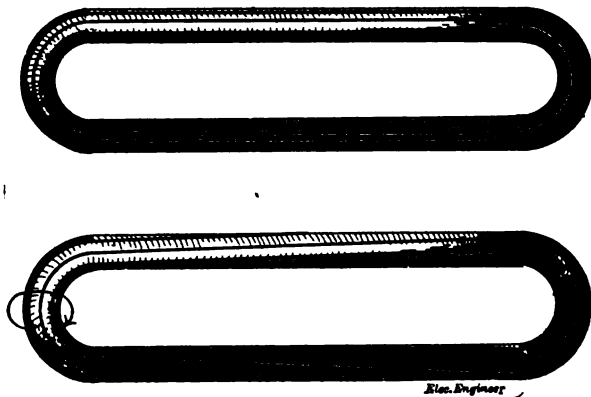
show that the law of the conservation of energy would be violated if the current did not reach a value exceeding $\frac{E}{R}$, and, further, that the only value of the current which will satisfy this law is $2\frac{E}{R}$, or a value double that furnished by Ohm's law.

Also, I wish to show, by mechanical analogy, as I have before claimed, that it is entirely feasible to introduce receiving apparatus at the distant end to absorb any required portion of the transmitted energy without disturbing the conditions of resonance.

Granting that these two statements are true, the future

1. THE ELECTRICAL ENGINEER, July 11 and June 27, 1894.
2. Electrical World, May and June, 1894.

of the practical utility of resonance in the transmission of power assumes an entirely different aspect from that pictured by Prof. Anthony and the editors of THE ELECTRICAL ENGINEER, for who will say that the one disadvantage of an increased dielectric strain at one known portion of the circuit is not more than offset by the advantage derived from the saving in copper effected by doubling the conductivity of the circuit and greatly reducing the enormous $i^2 R$ loss which now takes place upon all long-distance circuits conveying alternating currents?



FIGS. 1 AND 2.

As it is well understood at present that the resistance, inductance and capacity of an electric circuit are correctly represented by the frictional resistance, inertia and reciprocal of elasticity respectively, of a vibrating mechanical body, and that the E. M. F. and current are correctly represented by the vibratory force and velocity of motion respectively of the same body, I shall, for the sake of clearness, represent the conditions of the electric circuit by a wire rope circuit, as in Fig. 1; preferring this to the straight string or fluid chamber shown by Prof. Anthony, as by utilizing the torsional vibration of the rope a clearer comparison with the electric circuit may be made.

Fig. 1 represents the rope circuit in a condition of rest, i. e. with no impressed E. M. F. Fig. 2 represents the same circuit when subjected to a steady E. M. F. at the left hand end and after the condition of uniform velocity (current) has been obtained. It will be noticed that on applying the E. M. F. and starting the motion, work had to be done upon the circuit due to the inertia of the rope (the inductance of the circuit); also that on account of the flexibility of the rope (capacity of the circuit) the left hand end of the circuit received a twist before the distant end was affected (corresponding to the electrostatic charge of the circuit which must be satisfied before a uniform current can result). Finally, however, a uniform velocity (current) is obtained of a value equal to the steady force applied (E) divided by the total frictional resistance of the rope which is rotating in a medium of air, oil, water or other substance. Now if r is the resistance for unit length and l the length

of the circuit, then the velocity (current) $i = \frac{E}{r l}$ (Ohm's

law). That this is the true value of the current may be shown by the application of the law of the conservation of energy; that is, the energy consumed as heat in the circuit must be equal to the energy transmitted to the circuit, for no other work is done by the circuit.

The energy consumed as heat in the wire rope is equal to the square of the velocity multiplied by the total frictional resistance, just as the energy consumed as heat in the electrical circuit is equal to the square of the current multiplied by the total resistance. Also the energy transmitted to the rope circuit is equal to the force applied multiplied by the velocity of motion, just as the energy

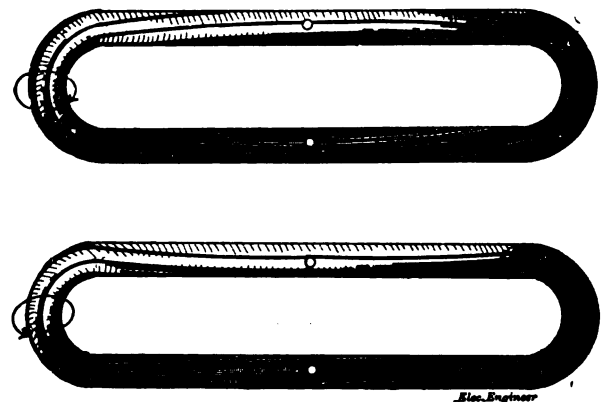
transmitted to the electric circuit is equal to the E. M. F. multiplied by the current.

Equating, we have $i^2 r l = E i$, and solving for i we get $i = \frac{E}{r l}$, Ohm's law, as before.

Now, let us suppose that in place of the steady E. M. F. we apply an alternating sine force to the circuit; also that the inertia (inductance) and flexibility (capacity) of the circuit are such that its natural period of vibration corresponds to the rate impressed upon it. Then the rope will respond to that force and vibrate in true resonance with a node in the middle of each conductor, just as Prof. Anthony so clearly showed by diagram in his article of July 11. Figs. 3 and 4 represent the rope thus vibrating. The force is applied at the left hand end. In Fig. 3 the twist has just reached its maximum positive or right hand value, and in Fig. 4 it has passed through its middle or zero position, shown in Fig. 1, and reached its maximum negative, or left hand value. It will be noticed that the right hand or distant end of the circuit vibrates in a similar manner to the transmitting end, but in an opposite direction, while the two middle points of the conductors are always at rest. If then the circuit is perfectly resilient, as we shall assume, the velocity (current) at the distant end is equal to the velocity (current) at the transmitting end, and is in phase with the E. M. F. at all points of the circuit; but the question is what is the value of this current? Is it

$$\frac{E}{R} \text{ or } \frac{2E}{R}?$$

It is evident that in this case, as before, the total energy transmitted is consumed as heat in the circuit, for no other work is done, and whatever energy is stored up as static energy during one portion of the cycle is restored as kinetic energy during the other. Then we will equate as before the total $i^2 R$ consumed as heat upon the circuit to the total energy delivered to the line and find what value i must have to satisfy this condition. First consider the current on the entire circuit at any one instant. This is represented in Fig. 5, where for clearness the rope is stretched out in a line, with the distant end in the middle. The full line represents the current at any one instant and the dotted lines the maximum values of the current during one complete cycle.



FIGS. 3 AND 4.

Now the energy consumed as heat at any instant is equal to the integral of the separate values of $i^2 r$ throughout the entire length of the circuit, or is equal to the average square of the current at that instant, times the total resistance ($r l$). But the average square of the current (sine curve) is equal to one-half the square of the maximum, or, for the instant considered, is $\frac{i_0^2}{2}$, where i_0 is the maximum value of the current for that instant. Hence at this instant heat is

being consumed at the rate of $\frac{i^2 r l}{2}$ per unit time. But the value of i , varies with the time and also varies in a sine curve; hence the average value of i^2 is $\frac{I^2}{2}$ where I is the maximum value of the current attained during the complete cycle. Hence the total energy absorbed as heat in the entire circuit is $\frac{I^2}{4} r l$, or is one-quarter the product of the maximum current and squared total resistance.

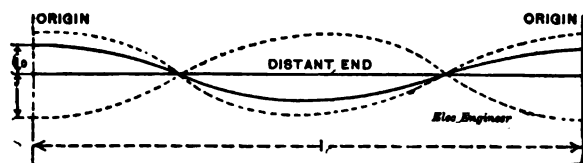


FIG. 5.

Now this quantity must be equal to the energy delivered to the line or to the integral of the instantaneous values of e and i . By assumption e varies in a sine curve with a maximum value of E , and i also varies in a similar sine curve coincident in phase with e ; but what is its maximum value? Is it $\frac{E}{r l}$, as Professor Anthony assumes, or is it

$\frac{2 E}{r l}$? If we assume that it is correctly given by Ohm's

law as does Professor Anthony then the total energy delivered to the line will be the mean square of e divided by $r l$, which is equal to one-half of the square of the maximum, E , divided by $r l$, or is equal to $\frac{E^2}{2 r l}$. But by Prof.

Anthony's assumption that $I = \frac{E}{r l}$,

$$\frac{E^2}{2 r l} = \frac{I^2 r l}{2} = \text{total energy delivered.}$$

But the energy consumed in the circuit is only $\frac{I^2 r l}{4}$.

Evidently the law of the conservation of energy is violated by the assumption that the current in a resonant circuit is governed by Ohm's law, for what has become of the remaining 50 per cent. of the energy which was delivered to the line? Now assume, as mathematical calculation dictates, that the current on a resonant circuit is double that given by Ohm's law and we have that the energy transmitted is equal to the integral of the instantaneous

values of $(e i = \frac{2 e^2}{r l})$, or is equal to the mean square of

the E. M. F. divided by $\frac{r l}{2}$ which is equal to one-half the square of the maximum, E , divided by $\frac{r l}{2}$ or $\frac{E^2}{r l}$. But by

assumption $I = \frac{2 E}{r l}$, hence $\frac{E^2}{r l} = \frac{I^2}{4} r l$, which is equal

to the energy consumed as heat upon the circuit and hence is in accordance with the conservation of energy.

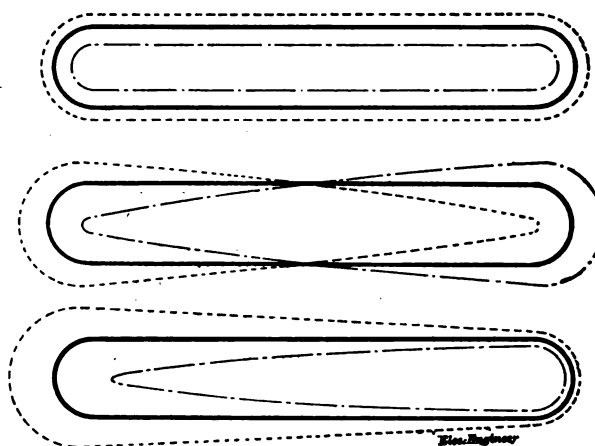
That the maximum current is equal to $\frac{2 E}{r l}$ should be

apparent from Professor Anthony's own paper, for he shows that when a circuit is in resonance and a node or absence of current is present at the middle points of the conductors, as at o in Figs. 3 and 4, then the $i^2 R$ loss upon that line will be but one-half the loss that would occur were there a uniform distribution of an equal cur-

rent throughout the entire length, as would result from a line devoid of distributed capacity and inductance and consequently obeying Ohm's law. Now *all* of the energy is absorbed as $i^2 R$; hence if the former circuit absorbs one-half the energy that the latter circuit does, it must receive but one half as much energy. But Prof. Anthony has taken cases in which the resistance and maximum current are the same in both cases, hence in the former circuit, the resonant circuit, the E. M. F. must be just one half as great as in the second. This of course proves the case for we have a resonant circuit transmitting the same current as a circuit devoid of inductance and capacity and with one half the E. M. F.

Figs. 6, 7 and 8 show graphically the distribution of the current upon a circuit which is supposed, in Fig. 6, to be devoid of inductance and capacity and consequently to obey Ohm's law; in Fig. 7 to have its capacity and inductance present in the required proportions to respond to the rate of alternations impressed upon it, and in Fig. 8 to have its capacity in excess of its inductance, which is the present condition upon commercial circuits. The three circuits are of equal resistances and have the same alternating E. M. F. impressed upon them. The current at any one point varies in a sine curve with the time, of course, and only the maximum values are shown.

It needs but a glance to show the advantages of the resonant circuit, for not only does it transmit twice the power that the circuit in Fig. 6 is capable of doing, but it transmits it by forcing the current away from the middle portions of the conductors, as it were, and piling it up at the distant end where it may be used to do useful work and thus reducing by one half the $i^2 R$ loss which would result upon the circuit were the same current transmitted with an even distribution. Also such a circuit avoids the large loss which now occurs in practice on account of the absorption of the current by the excess of electrostatic capacity of the circuit and which causes a rapid decrease in the current as the distance from the transmitting end increases—as shown in Fig. 8. Farther such a resonant circuit avoids the loss due the difference in phase between the current



FIGS. 6, 7 AND 8.

and E. M. F. which is unavoidably present in such a circuit as shown in Fig. 8—for in a resonant circuit the current and E. M. F. must coincide in phase.

Up to this point the circuits have been assumed to contain no receiving apparatus at the distant end and consequently have absorbed all of the power transmitted as $i^2 R$ loss upon the line.

Now Prof. Anthony claims that if receiving apparatus, such as motors or transformers, be placed at the distant end and if they be required to absorb any great amount of power then it will no longer be possible to secure a resonant circuit even if it should be advantageous to do so.

(Continued on page 112.)

THE ELECTRICAL ENGINEER.

[INCORPORATED]

PUBLISHED EVERY WEDNESDAY AT
303 Broadway, New York.

Telephone: 3360 Cortlandt.

Cable Address: LENGINEER.

Geo. M. Phelps, President.

F. R. COLVIN, Treas. and Business Manager.

Edited by

T. COMMERFORD MARTIN AND JOSEPH WETZLER.
Associate Editor: GEORGE B. MULDAUR.New England Editor and Manager, A. C. SHAW, Room 70—630 Atlantic Avenue,
Boston, Mass.Western Editor and Manager C. KAMMETER, 1439 Monadnock Building, Chicago,
Ill.New York Representative, 303 Broadway, } W. F. HANKE.
Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada, - - - - -	per annum, \$3.00
Four or more Copies, in Clubs (each) - - - - -	2.50
Great Britain and other Foreign Countries within the Postal Union " - - - - -	5.00
Single Copies, - - - - -	.10

[Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1893.]

EDITORIAL ANNOUNCEMENTS.

Addresses.—Business letters should be addressed, and drafts, checks and post-offices orders made payable to the order of THE ELECTRICAL ENGINEER. Communications for the attention of the editors should be addressed, EDITOR OF THE ELECTRICAL ENGINEER, 303 Broadway, New York City.

Communications suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.

Advertisements.—We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers.

VOL. XVIII. NEW YORK, AUGUST 8, 1894. No. 327.

CONTENTS.

EDITORIAL :—	PAGE.
Progress in Arc Lighting.....	110
Modern Disinfection.....	111
Overhead Trolleys Without Poles.....	111
ARTICLES :—	
The Treatment of Drinking Water, Sewage, Garbage and Diseases by Electrosone (illustr.).....T. C. MARTIN.	101
The Resonance of Electric Circuits (illustr.).....F. W. DUNBAR.	107
Electricity as a Fire Hazard.—VI. (illustr.).....W. J. JENNER.	113
The Positive Electric Car Lighting System (illustr.).....	114
World's Fair Awards on Wire.....	116
LITERATURE :—	
"Electricity at the World's Columbian Exposition.".....	114
LETTERS TO EDITOR :—	
The Energy Needed by a Moving Train.....G. H. THAYER.	115
Testing Dryness of Steam.....E. H. PRABODY.	115
Locating Faults and Crosses.....L. C. HILL.	115
Utilizing Grades.....H. W. BARTOL.	115
PERSONAL :—	
Mr. Henry Gordon Stott.....	115
NEWS AND NOTES :—	
Fire at the Siemens & Halske Works.....	114
The Telephone in Mexico.....	115
Rocky Mountain Bell Telephone Co.....	115
INVENTORS' RECORD :—	
Classified Digest of U. S. Electrical Patents Issued July 31, 1894.....	116
REPORTS OF COMPANIES :—	
The Rice Electric Specialty Co.....	117
Latest W. U. Acquisition.....	117
SOCIETY AND CLUB NOTES :—	
Convention of the Association of Edison Illuminating Companies.....	117
The Society of Heating and Ventilating Engineers.....	117
TRADE NOTES AND NOVELTIES AND MECHANICAL DEPARTMENT :—	
The Mather Multipolar Generator (illustr.)—General Electric Launch Co.—Hartman & Braun's New Catalogue.....	118
General Electric Alternating Fan Motor (illustr.)—A Large, New Fort Wayne Alternator.—"N. I. E." Wires and Cables.—Cutter's Cord Ad- juster (illustr.).....	119
A Genuine Electric Hair Brush (illustr.)—Sales of Harrisburg Ideal Engines.—Accident to C. H. Rudd.—New York Notes.—Western Notes.	126

PROGRESS IN ARC LIGHTING.

ONCE in a while doubts are expressed as to whether the arc lamp will continue in vogue much longer, but despite all the criticisms against it and the objections to it, the arc goes on gaining ground in its chief field of usefulness, that of street lighting. It may be doubted whether it holds its own as a means of interior illumination, although recently the constant potential lamp has somewhat readjusted conditions; but in all other respects the arc lighting industry is perhaps in as hopeful a state as it has ever been since its first great boom in the glorious, golden days of Brush, nearly twenty years ago, when lamps rented at \$1 per night and carbons cost \$80 per thousand.

Mr. S. M. Hamill, well known through his active connection with arc lighting, contributes to the *Engineering Magazine*, this month, a very interesting article on the general subject, tracing its history, depicting its growth, and doing but justice to the pioneer work of Brush and others. Mr. Hamill divides arc lighting into three periods, namely, from 1810 to 1876; from 1876 to 1894; and the future. We do not quite understand why the second period ends this year, but should have been inclined ourselves to place it a little further back, when the large arc dynamos began to be built. Mr. Hamill himself seems, from casual expressions, to be of this opinion. He says: "The arc dynamo will be made in larger units." But it is, as he intimates also, for there are already three or four makes in this country alone, running up to from 150 to 200 arcs, representing the enormous E. M. F. of 7,000 or 8,000 volts. It was in fact the small unit of arc dynamo that kept down profits, after prices for city lighting declined, and which even to-day makes the incandescent service more remunerative than that of the arc, under the same management. One paragraph in Mr. Hamill's thoughtful article bears on this very point. He says:—

The great problem of the future lies in the management of local electric light companies. In these modern times, it is little we care for glory. Dividends are the cry of the hour. How to earn them is the problem. There are in this country three large arc-light stations under one management in a city of 500,000 inhabitants, earning from 12 to 15 per cent. on the actual cost invested. An electric light station in another town earns about the same. Both of these companies are operating under ordinary conditions. A company in a city of 40,000 inhabitants, using certain machinery, with a valuable city lighting contract, lost money and failed. Another company with the same machinery under different and very conservative and economical management, and a much lower contract for lighting with the city, earns from 15 to 20 per cent. on the actual investment. A company in a town of 5,000 people became bankrupt and was sold at a receiver's sale. New management, practically under the same conditions, earned satisfactory dividends for the stockholders. These examples would indicate that there is a large remuneration from such investments, notwithstanding the fact that a large number of electric light companies in the country have lost money.

No doubt, the element of skillful executive control comes in, but the small unit with its corresponding inferior arrangements of steam plant has but too often been a fatal handicap. To-day, in many cities, the largest unit obtainable is an absolute necessity, especially where subway conditions require as much current as possible from one machine to be crowded upon the one wire, subject, as each wire is, to heavy duct rental.

Mr. Hamill points out that in our largest cities the actual arc lighting is far short of the requirements. In Cleveland, for example, the birthplace of the modern arc and

the home of Brush, there are only 245 when there should be 3,000 at least; and so it goes all along the line. But it seems to us very much open to question whether the new work will all be series lighting of the old familiar style; and it must not be forgotten that thousands of arcs, including a great many for streets, are now running on the incandescent mains. The alternating arc is also destined to cut much more of a figure. One great element of disappointment about the old arc circuits has been their inability to subserve, as the incandescent circuits have done, the uses of power distribution. At one time, arc motors were all the cry, but now while some are in use they are put to utter insignificance by the constant potential motors whose number must be up in the hundreds of thousands. Thus, too, for long distance power transmission, the indications are that high voltage direct systems will give way before the later apparatus of "phase" type.

But after all, the arc light industry has seen a wonderful development, more in America perhaps than anywhere else; while it is certain that American arc lamps and dynamos have been those to illustrate the doctrine of the survival of the fittest. Mr. Hamill says that one parent company has built no fewer than 150,000 arc lamps and 5,000 arc dynamos. Another has turned out as many as 100,000 lamps. Of carbons, he says that the Brush factory made 26,000,000 in 1893, and that the new National factory is rated at a capacity of 2,500,000,000, an incredible number that we take only on Mr. Hamill's well-known reputation for conservative figuring. It is estimated that there are 400,000 arcs burning nightly in this country, which could be carboned a great many times every day, every one of them, without causing the National factory to work nights. Such preparations betray no anxiety as to the continuous growth of the arc lighting industry.

It is well that such an article as Mr. Hamill's should be written in a magazine reaching so many intelligent readers interested in the arts and sciences. His narrative shows in many ways that what has been characterized as "shoe string" and "clothes line" lighting has had a great many serious problems to overcome in reaching its present stage of perfection, and that a high order of inventive genius has been called upon to meet the difficulties. It shows, too, that the industry to-day, while in no sense a "bonanza," is in such shape that to able managers and well trained electrical engineers it offers a bright and prosperous future. If some of the 1,500 young men who will, as Mr. Hamill reckons, graduate from the schools this year as electrical engineers, would only turn their attention to practical arc lighting instead of trying to theorize a new phase dynamo into existence or invent a new railway motor, they would find good places for themselves in the long run and greatly benefit the art.

MODERN DISINFECTION.

REFERENCE was made in these pages last week to the activity in modern times, in matters of sanitation, and to the general recognition of the fact that public health is affected very favorably by the steps taken for the purification of drinking water, the disinfection of sewage and the disposal of garbage. Note was made, in this connection, of the work now in progress at Riker's Island, where sev-

eral acres of solid garbage, the accumulation of seven months' steady dumping, are being sterilized and deodorized by a liberal application of electrozone.

Deeming the matter of more than usual importance, one of the editors of this journal has made it his business to investigate the work at Riker's Island, and the results are printed in our present issue. It will be seen that the article is a simple statement of facts, from which our readers may draw their own conclusions. Having, however, been witnesses also of the work previously carried out successfully at Brewster's, with electrozone, in the purification of both drinking water and sewage, we do not hesitate to express our own conviction that electricity has now furnished sanitary and medical authorities with a most powerful agent for good. It seems impossible that so many investigators and observers in so many different fields can be mistaken; and, if they are not mistaken, then the widespread use of electrozone becomes a matter of necessity and duty. For many of the large cities of the world, the supply of sea water to be electrolyzed is easy and inexhaustible; while for inland centres of population the production and treatment of salt water should prove neither difficult nor expensive.

Two full pages of *Harper's Weekly*, of August 4, and an editorial, are devoted to the nuisances on Newtown Creek, Brooklyn. Our contemporary calls with energy upon the Brooklyn authorities to rectify the evils there at once, to fill in the Creek, and to reclaim the low lands. We venture to direct the attention of the *Weekly* and of the Brooklyn authorities to what electricity has done at Brewster's and Riker's, and to suggest a trial, right off, of the same remedy. As we go to press, we note the commendation by the New York Grand Jury of the work at both places, and their remark, as to Riker's, that the land thus reclaimed from the river and built up from purified street sweepings, "will be of inestimable value to our city in the near future." Once again, electricity proves itself to be a potent agent in raising the standard of city comfort, convenience and cleanliness.

OVERHEAD TROLLEYS WITHOUT POLES.

NOT long ago we illustrated and described the method adopted in Bremen, Germany, of suspending the overhead trolley system of wires from rosettes fastened into the fronts of the houses. It is now reported from Chemnitz, Saxony, that a similar method has proved very satisfactory there, owners of houses preferring to allow the use of their walls, and objecting to the obstruction of their sidewalks with poles.

One interesting feature is that in Chemnitz the introduction of electricity has increased the traffic earnings 60 per cent., and this in spite of the fact that car conductors have been abolished. The cars now have only a motorman. It is figured out that if 150,000 passengers should prove dishonest in 12 months, this would only mean a loss of 15,000 marks, whereas the conductors' salaries would amount to 450,000 evasions of payment of fare. It is not thought that the company loses anything like as much as 15,000 marks. The experience in this country with "bob-tail" cars has always, we believe, been considered as conclusive proof that they are not a success.

(Continued from page 109.)

I have shown that an electric circuit containing distributed inductance and capacity is the equivalent of a mechanical body containing *distributed* inertia and elasticity. It is not necessary to assume, of course, that the vibrations of the mechanical body are *torsional*; they may be longitudinal or transverse. Thus a piano or violin string tuned to its proper pitch represents equally well the resonant circuit. Now I wish to draw the distinction between resonance in circuits containing distributed inductance and capacity from those containing localized inductance and capacity. In the latter case it is well known that the ultimate value of the current when in resonance is

that value given by Ohm's law $\left(\frac{E}{R}\right)$, while I have shown

that the ultimate value of the current in circuits containing distributed inductance and capacity when in resonance is $\frac{2E}{R}$.

If we take a light but strong and elastic spiral steel spring and place a heavy lead weight upon it, as in Fig. 9, then we have a combination of localized inertia and elasticity; just as if we place an electro-magnet in series with a condenser (also shown in Fig. 9) we have a combination of localized inductance and capacity. Now such a combination will evidently respond to but one rate of alternation and when that particular rate is impressed, the combination will vibrate with a velocity (current) at all times just equal to the impressed force divided by the total frictional resistance of the medium in which it is placed. Now this is, of course, Ohm's law $\left(\frac{E}{R}\right)$. It differs from the case of *distributed*

inductance and capacity because all parts vibrate together with the same velocity instead of dividing up into nodes and anti nodes as in the case of distributed inductance and capacity as shown in Figs. 3, 4 and 5.

Now to return to the problem. Fig. 10 represents the rope circuit stretched out as in Fig. 5, for the sake of clearness. The distant end is in the middle and the two ends are the points at which the force is applied. The middle point is connected by a link to a wheel which is to be vibrated by the vibrating rope as in Prof. Anthony's illustration. Now it is evident that if the inertia (inductance) of the wheel is slight, then although the amplitude of the vibrations of the rope and consequently the velocity (current), will be decreased, and decreased to an amount depending upon the frictional resistance of the wheel, yet

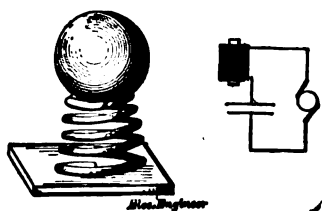
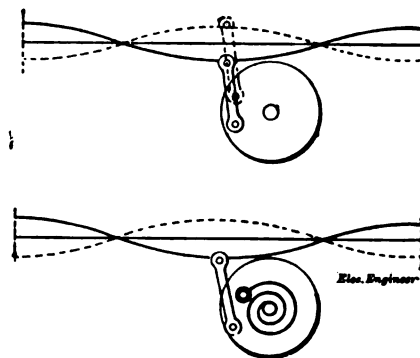


FIG. 9.

the *time* of vibration and resonance of the circuit will not be disturbed. But if the inertia (inductance) of the wheel is great and if there is no compensating elasticity (capacity) then the vibrating rope would be thrown out of unison and the resonance destroyed. To be sure the rope would still vibrate but the inertia of the moving wheel would introduce a back E. M. F. almost 90° behind the acting E. M. F., so that the resulting E. M. F. would no longer be even approximately in coincidence with the current and hence but little power could be transmitted. This is undoubtedly the case to which Prof. Anthony refers—but is not this the well-

known case of a transformer on no load at the distant end of a circuit?

Now suppose that the receiving apparatus is tuned to the rate transmitted, by the well-known methods of combined localized capacity and inductance;—that is, suppose the wheel in Fig. 10 is provided with a spiral spring, as in Fig. 11, which will give the wheel a natural period of its own equal to the rate which is to be transmitted. Then is it not evident that although the amplitude of vibration of the rope and consequently the velocity or current will



FIGS. 10 AND 11.

be decreased and decreased to an amount depending upon the amount of energy absorbed by the wheel, still the rate and time of vibration will remain unchanged, for nothing has occurred to cause a change?

A large portion of the transmitted energy may now be given up to the wheel as it now vibrates in unison with the circuit, just as a large portion of the energy of vibration of a piano or violin string may be, and *is*, transmitted and given up to the sounding board of the piano or violin; yet we know that the resonance of the string is unaltered by this transmission of energy.

Now one word in reference to the increased stress brought upon the dielectric at the nodes of a resonant circuit, and which Prof. Anthony states may be hundreds or even thousands of times the E. M. F. of the generator. The E. M. F. at the node in a resonant circuit may readily be shown to be for each volt of E. M. F. applied at the generator, equal to the hypotenuse of a right triangle of which one side is the distance of the node from the generator expressed as a fraction of the entire distance to the distant end (in this case $\frac{1}{2}$) and the other side is equal to $\frac{4Ln}{R}$, where L is the

inductance in henrys, R the resistance in ohms and n the number of alternations per second. Now the condition of *perfect* resonance is that Ln shall not be less than $2.5R$. In other words no advantage will result from increasing Ln above $2.5R$ although it may be advantageous in many ways to make Ln less than $2.5R$ even at the expense of not securing a perfectly resonant circuit. Similarly in vibrating strings no advantage will result from making the product of the moment of inertia and rate of alternation greater than 2.5 times the frictional resistance of the medium in which they vibrate. Thus there is no advantage in making the higher pitched strings of certain musical instruments out of steel or other material of large inertia for this reason alone, as the frictional resistance of the air is small,—but if a medium such as heavy oil or cold molasses were substituted for the air, it is evident that a steel wire would have a material advantage over a feline intestine for violin purposes. But even assuming that we make $Ln = 2.5R$ we have for the second side of the right triangle a value of 10 only—and consequently would have at a maximum only 10.02 times the E. M. F. of the generator at this one point upon the circuit; objectionable, to be sure, but not as objectionable as if it were hundreds or thousands of times,

as Prof. Anthony states. It must also be remembered that this would be the value upon a circuit containing no load at the distant end and consequently is far in excess of the value which would result were the circuit doing useful work at the distant end.

In this same connection Prof. Anthony has misunderstood my comparison of a non-resonant circuit to a "loose light string." When the resistance of an electric circuit containing considerable capacity is far larger than the product of its inertia (inductance) and rate of alternation, then such a circuit is the equivalent of a string of considerable flexibility (capacity) in which the frictional resistance is large in comparison with its inertia. Such a string is correctly described as a "light loose string" and it is quite evident that although it may not be naturally vibratory, still it may have vibrations thrust upon it. Now if a certain vibratory force is applied to the string it will be *compelled* to vibrate at the transmitting end and to vibrate with a large amplitude, and as it is not naturally resonant it cannot transmit these vibrations to the distant end without great loss. There is but one way for this last power to be absorbed and that is, as I have stated, by uselessly heating the conductors, or the string, in this case. I have previously stated that the conditions at present upon all commercial long distance circuits are similar to the conditions upon the light loose string. They may be *made* to vibrate and transmit power but only at the expense of a large percentage of loss due to the useless heating of the conductors.

The longer the circuit the greater is this useless loss; thus upon the long distance telephone circuit between New York and Chicago containing 400 tons of copper the loss is fully 80 per cent.

ELECTRICITY AS A FIRE HAZARD.—VI.

BY W. J. JENKS.

The dangers attending the intimate contact with conducting material of both wires of even a low pressure system, such as is usually employed to directly supply incandescent lamps, were intensified when both gas and electricity were used in the same fixture, or so arranged that gas under pressure was always present in the main pipe or stem, and electrical tension was always on the wires. While each worked perfectly and independently while under control, there was always great danger that either would, if it escaped from that control, immediately proceed to liberate the other. The gas would at once begin to disintegrate the insulating covering of the wire; the electricity would heat and melt the pipe and set free the gas; with both at liberty there was almost a certainty of fire.

All sorts of clumsy attempts were made to hold the wires at a safe distance from the gas fixture, and one or two of these are illustrated by "Diagram 7—Aerial Insulation of Conductors on Gas Fixture carrying Incandescent Lamps." One plan is shown at A, and involved the use of the metallic spur attachment *a*, the insulating thimble or bushing *b*, and the lamp socket *c*, such socket having holes bored through its outer shell for the introduction of the wires. The other device shown at B of the same diagram consisted of a metallic arm *e*, adapted to be fastened to the gas burner by a set screw, and carrying at its lower end a wooden insulating piece *d*, through the opposite ends of which the two wires passed and entered the socket *c*, as in the other case.

These unsightly arrangements were rendered unnecessary by the adaptation of the insulating joint to the admission of gas to the main stem and gas arms of the fixtures, and the concealment of the electric wires between the pipes and ornamental shell and within special lamp arms corresponding in general design with the outlines of such fixtures as were acceptable to the public.

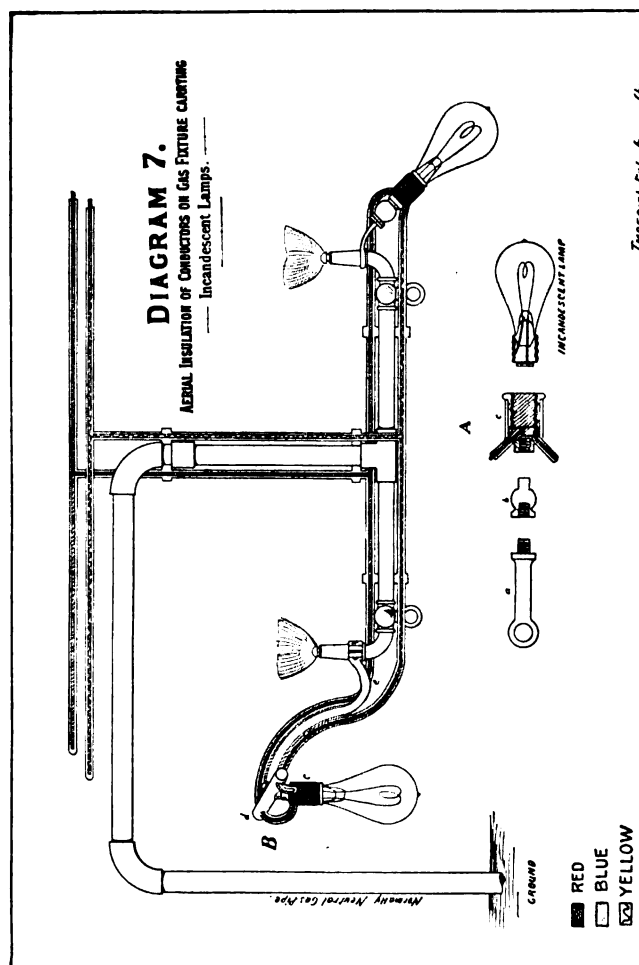
By such means, in connection with the improvement of the insulating wrapping of wires, electroliers and also combination gas and electric fixtures have been produced, which, when properly installed, completely answer the former objections of the underwriters. But it must be understood that the same laws and conditions which have made the metallic pipes of fixtures a source of difficulty, apply to any poorer conductor, such as damp wood-work, stone or brick walls, as well as crossing wires, water and drain pipes and the like, and demand that special forms of insulating material, preferably non-combustible, shall be employed, and particularly that in moist localities all electric light or power conductors shall be, so far as possible, aerially suspended so as not to depend too much upon the primary wrapping or covering, or

else that they be confined within moistureproof conduits or wire-ways.

In a paper read before the Society of Arts, Boston, April 18, 1893, by Captain William Brophy, who has long been recognized as one of the most conservative and intelligent insurance inspectors in this country, after referring to the slow growth of the telegraph and telephone systems of conductors and the occupation of the streets by pole lines and wires, the speaker considered the presence of overhead wires in streets, as affecting the action of firemen in times of exposure. He said:—

"With this enormous increase of electric wires, the delays to the fire department became more frequent and losses by fire were often greater than need be, due to this cause; yet they did not endanger the lives of the firemen to any great extent, and were handled without fear.

"Later came that new form of electric energy—the electric arc light. Gradually it worked its way into public favor and gradually its power for mischief to the fire underwriters and owners of property became manifest by reaching the pockets of both. This was inevitable owing to the first crude methods resorted to for the transmission of this new form of energy. The



existing forms of insulation were not equal to the task of confining this greatly increased force within bounds.

"With the introduction of this class of wires came another obstruction to the efforts of the firemen in extinguishing and preventing the spread of fires, and also a certain amount of demoralization in their ranks. Men who would face the flames, inhale poisonous gases, and stand beneath tottering walls without flinching, stood in wholesome dread of the arc light wires. The former elements of danger they were familiar with and could to some extent avoid them, while the latter contained hidden and to them mysterious dangers that they knew very little of. To handle such wires or come in contact with them meant injury or death. In addition to this they soon learned that the wires they had been accustomed to handle with impunity and remove them when they became an obstruction, were liable to become dangerous also, and as a matter of fact firemen are justified in refusing to handle electric wires in towns or cities where an arc light plant is installed, unless during the hours when it is not in operation.

"Next in order came the incandescent electric light, direct or low tension system. While the wires for this system proved

another obstruction, they were not dangerous to life and limb; yet firemen, who are not expert electricians, looked upon them with mistrust. Later still came the electric power circuits. At first no greater than the usual 110 volt current was used, which is not dangerous to human life. Later this was increased to 220 in order to reduce the cost of conducting wire.

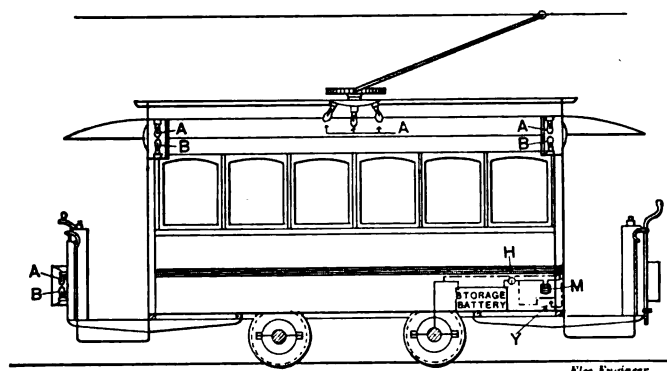
"Next came the transformer system of electric lighting, where a current of 1,000 to 2,000 volts is used in the primary conductors from dynamo to transformers. These were another obstruction and dangerous to the person.

"About the same time came the electric street railroads with their trolley wires, feeders, span and guard wires. That these prove a serious obstruction at fires no sane man can deny. They are also a source of danger to the firemen and contact with them is studiously avoided by those brave guardians of our lives and properties."

THE POSITIVE ELECTRIC CAR LIGHTING SYSTEM.

For the last three weeks the North Hudson County Railroad has had in operation upon one of its cars an ingenious system of auxiliary lighting owned by the American Manufacturing and Engineering Company, of 143 Liberty street, New York city, and known as the "Positive Electric Car Lighting System." The trial equipment has given perfect satisfaction thus far, and last week an opportunity was given a number of newspaper men and others to see the operation for themselves.

The accompanying illustration clearly shows the operation of the system, which is designed to supply light in case the trolley should leave the wire, the circuit should become broken, or the apparatus at the power house become disabled, and also to afford



THE POSITIVE ELECTRIC CAR LIGHTING SYSTEM.

the car cleaners a good light while at work and avoid the danger and trouble of carrying lanterns or candles. The use of oil lamps in a car is obviously objectionable. It calls for indifferent attendance, and is of more or less trouble to the conductor or motorman. It has been well said that the use of oil lamps in electric street cars, is like keeping horses stationed along the track to help out the motor, and this apparatus enables one to overcome the objectionable feature of substituting anything for the electric current, even for signal or head light purposes.

In ordinary street railway practice a shunt current is passed through five incandescent lamps to the rail or return circuit. In this system the current passes through and lights these same lamps, but it also passes through the electromagnet M, switch H, storage battery S B, to the axle of the car wheel and rail to ground, energizing the electromagnet whose armature is drawn forward, and at the same time charging the storage battery.

If the trolley comes off, the current gives out, or is interrupted in any way, the armature of the magnet falls back against its back stop X, closing the supplemental circuit from the storage battery through the switch to the armature of the magnet, the back stop and the lamps B B, and returning to the storage battery, thereby insuring light in the car whenever lights are required, independently of the action of the trolley.

When the main circuit is restored, by replacing the trolley, or otherwise, the current takes its original course through the main circuit lamps, energizing the magnet and drawing its armature away from the back stop, and recharging the storage battery and lighting the car as before, thus automatically and positively insuring a constant light in the car under all circumstances.

Objection had been made to the entire displacement of oil lamps in a car, as it would be necessary to use a torch to examine the machinery, etc., in case of any trouble that might occur as they now use the car lamp. This objection is met in this system by the fact that each car would have at command a much superior light to any now used, as a portable electric lamp with cord and plug could be carried by each car and con-

nected with one or another of the auxiliary sockets in case of need.

In case a light is required in the car when it is in the barn and disconnected from the trolley circuit, these auxiliary lamps are always in readiness.

In fact, this system is always ready to let its light shine on all occasions, when and where required, and, as the cost is low, should meet with favor.

LITERATURE.

"ELECTRICITY AT THE WORLD'S COLUMBIAN EXPOSITION."

Mr. J. P. Barrett, city electrician of Chicago, and the Electrical Commissioner of the World's Fair, announces as ready for publication his book entitled "Electricity At The World's Columbian Exposition." In the preparation of this beautiful and interesting volume, Mr. Barrett has had the invaluable assistance of Dr. Hornsby, through whose hands all the matter has passed. The book is not only full of data,—historical, technical, etc.—but is richly embellished with hundreds of choice engravings. It is also handsomely bound in decorative cloth covers. The price of the volume is only \$2.50, and it could not be sold for that sum had not many of the exhibitors in Electricity Building guaranteed in a measure the cost of its production. It is likely soon to run out of print, and we advise our readers to secure copies at once. All orders should be addressed direct to J. P. Barrett, City Hall, Chicago.

FIRE AT THE SIEMENS & HALSKE WORKS—WORK RESUMED AT ONCE.

THE fine new works of the Siemens & Halske Company at Chicago were almost if not entirely destroyed by fire on the night of July 1st, owing to the outbreak of a bad fire in a neighboring lumber yard. The loss in the district was \$3,000,000; the loss to Siemens & Halske is put at about \$600,000, but they are well insured. Mr. C. D. Shain, the General Eastern Agent, has received from them the following dispatch: "Factory burned; will resume manufacturing immediately and deliver within ninety days. Patterns and plans saved."

The tendency for very large electric direct coupled generators, especially for railway power plants, has been illustrated again in a contract just closed between the West Chicago Street Railway Company and the Siemens & Halske Electric Company of America, for three 2,000 horse power and one 1,000 horse power generators.

The contracts for the construction of the North Side power house and for the engines and machinery have also been given out. The station will ultimately take in generators aggregating 6,000 horse power. At present it is only the intention to operate 185 cars from that station, and the contracts, which were let Monday, called for generators aggregating 2,800 horse power. Contracts for the engines were let to the Fraser-Chalmers Company, and for the electrical machinery to the Siemens & Halske Electric Company.

The following list of Siemens & Halske railway plants erected or under construction, speaks for itself:

	Total Electrical H. P.
Garden City Construction Co., Chicago.	
Four 620 H. P. Generators.....	2,480
West Chicago Street Railway Co., Chicago.	
Three 2,000 H. P. Generators.....	7,000
One 1,000 H. P. Generator.....	
Johnson & Edwards, Contractors for Nassau Electric Railway Co., Brooklyn, N. Y.	
Three 667 H. P. Generators.....	2,000
Toronto Street Railway Co., Toronto.	
Two 1,400 H. P. Generators.....	2,800
City Railway Co., Dayton, Ohio.	
Three 400 H. P. Generators.....	1,200
Ringier Rocks St. Ry. Co., Pottstown, Pa.	
Two 135 H. P. Generators.....	270
Cincinnati Street Railway Co., Cincinnati, O.	
One 650 H. P. Generator.....	650
Total.....	16,400

The above table gives the rated capacity of these generators only, while those that have been in actual service have shown their capacity to stand an overload of 50 per cent. for hours without harm or flashing at the brushes.

DR. ALLAN J. HORNSBY, of Chicago, has been in town this week on affairs connected with the National School of Electricity, the new book he has edited on the World's Fair, and the final matters connected with the electrical awards made at the Fair.

LETTERS TO THE EDITOR.

THE ENERGY NEEDED FOR A MOVING TRAIN.

In your issue of July 11 on page 82, 2nd column, 9th line from the bottom of the page, are the following words:—"The energy in the moving train then is 125 H. P. minutes."

The velocity of the train is 25 miles per hour = 2196.48 feet per min. The weight of the train is 95.5 tons, and the drawbar pull is 6 lbs. per ton. $\therefore 95.5 \times 6 = 573$ lbs. = energy required to keep train moving at 25 miles per hour.

$$\text{Horse-Power} = \frac{2196.48 \times 95.5 \times 6}{33000} = 38.138 \text{ Horse-Power.}$$

Or again:—The energy required to bring this train up to full speed from rest = mean velocity $\times$ pull on drawbar.

$$\therefore \text{Horse-Power} = \frac{490 \times 573}{26.7 \times 550} = 19.1 \text{ Horse-Power.}$$

If Mr. Thayer or some other kind genius will kindly enlighten me on this subject, he will obtain the thanks of yours hopelessly,
THICKHEAD.

BROOKLYN, July 16, 1894.

Your correspondent seems to be confused both as to the meaning of the term "energy in the moving train" and the method of its calculation. I would refer him to any good text book on mechanics where he will find the matter treated in full. The following explanation may be sufficient:—The energy in the moving train is distinct from the horse power required to keep the train in motion. It depends upon the weight of the train and its velocity and is independent of the track resistance. The energy in a moving cannon ball is of the same nature. Suppose in order to simplify matters that there is no rolling friction. The work done by the engine or motor in getting the train up to a speed of 25 miles per hour is the equivalent of 125 horse power exerted upon it for one minute. Now suppose the ordinary conditions of track resistance exists from that time on and it will require 38 horse power to maintain that speed.

The calculation is as follows:—

Work or energy = $\frac{1}{2} M V^2$ where

M = Mass or weight + $g = \frac{\text{weight}}{32.2}$ (in pounds)

V = velocity in feet per second.

H. P. minutes = ft. lbs. + 33000.

$$\text{H. P. min.} = \frac{\text{work}}{33000} = \frac{\frac{1}{2} \times \frac{95.5 \times 2000}{32.2} \times \left\{ \frac{25 \times 5280}{60} \right\}}{33000} = 125 \text{ H. P. min.}$$

GEO. H. THAYER.

CHICAGO.

TESTING DRYNESS OF STEAM.

I was pleased to see Mr. R. S. Hale's letter of July 7, and the sketch of his connections. The fact that his calorimeter uses 240 lbs. of steam per hour shows that the orifice is much larger than the usual practice. It is true, however, as he suggests, that 6 per cent. of 80 is 4.8, or say 5 lbs. This in 20 minutes would be 4 oz. per minute. Whether the larger amount of 20 per cent. would be condensed depends on the condition of temperature and pressure and on the length of pipe, etc., but the opportunity for water to collect in some portion of the pipe is also an important consideration.

From the wording of Mr. Hale's letter I understand that he makes his throttling calorimeter show 6 per cent. of moisture. I should be pleased to learn how he does it.

The fact that the tests show drier steam when the fires are banked or the stop valve closed is exactly what I should expect, as when there is no current in the pipe the moisture simply runs down to the lowest point possible and stays there quietly. Mr. Geo. H. Barrus assumes that under such conditions the steam is perfectly dry and he bases all his calculations for moisture on readings taken at such times.

I should like very much to know what results Mr. Hale would obtain by putting his collecting nipple in the cross pipe just above one of the drums. If the boiler is priming he ought, of course, to get the same figures.

The following incident in my experience may be of interest. The boiler to be tested was of the Babcock and Wilcox double deck type and was furnished with an angle stop valve that closed automatically, when the pressure in the boiler became less than that in the main. A nipple had been put into the cross pipe just under the stop valve but there being too little room in that position for the Barrus calorimeter that was to be used, another nipple was put into the side of the steam pipe about 3 feet from

the stop valve. This pipe curved upward on a radius of about 8 feet to meet a Y-fitting connecting with the main and with the steam pipe of an adjoining boiler. The calorimeter therefore took steam from the horizontal part of the pipe—an arrangement never to be recommended and which in this case proved very unsatisfactory. As soon as the test was started large amounts of water (35 per cent.) began collecting in the drip box.

This action was intermittent and I noticed that it was in nearly every case accompanied by the pounding of the stop valve on its seat showing that at the time of the occurrence of the water in the sample of steam the pressure in the boiler was slightly less than that in the steam pipe.

This fact lent color to the condensation theory and simply as an experiment I replaced the calorimeter with a short nipple and allowed steam to flow directly into the atmosphere. At the same time I let steam flow from the nipple in the cross pipe. The comparison of the two jets was of the greatest interest. At times the jet from the steam pipe was blue or invisible where it issued into the air; at other times it was very white and cloudy and considerable water dripped from the end of the pipe. The other jet, at all times, was invisible within 2 inches of the pipe except for an occasional momentary streak of white.

Now it seems to me that this goes to show something and I hope that Mr. Hale will find time to try his calorimeter on the crosspipe.

E. H. PEABODY.

NEW YORK CITY, July 28, 1894.

LOCATING FAULTS AND CROSSES.

In the article on "Locating Faults and Crosses" which appeared in the last number of THE ELECTRICAL ENGINEER, I notice two errors which might be misleading. The line which now reads: "1st, connect a and b and read ammeter and voltmeter," should read "connect A and B and read ammeter, etc." The same correction should be made at the top of the next column.

LOUIS C. HILL.

GOLDEN, Col.

UTILIZING GRADES.

In several of your numbers you have published articles about the great expenditure of power required in starting trains on elevated railroads. Why would it not do to lay the track, approaching the station, on an up grade and leaving it on a down grade, and thus aid in stopping and starting the train?

H. W. BARTOL.

PHILADELPHIA, July 30, 1894.

PERSONAL.

MR. HENRY GORDON STOTT, electrical engineer of the Buffalo General Electric Company, Buffalo, N. Y., was married on July 23d to Miss Anna Mitchell, daughter of John K. Mitchell, of Belfast, Ireland. The ceremony was performed by the Rev. C. S. Brown, of St. Peter's, Brooklyn, at the home of the bride's sister, Mrs. Mitchell, St. James Place, Brooklyn. Mr. Stott has been some time in Buffalo, and was at one period electrician on board the cable-laying steamer "Minia."

THE TELEPHONE IN MEXICO.

The operations of the Mexican Telephone Company for the months of March, April and May show this comparison with last year:

Three months ended	1894.	1893.	Inc.
May 31.			
Earnings	\$27,252	\$24,751	\$2,501
Expenses	13,757	18,652	105
Net	\$13,495	\$11,099	\$2,396
Telephone collections	26,810	24,141	2,669
Other income	442	610	*168
Maintenance	1,079	948	131
Construction	2,220	1,419	801
Taxes	1,410	1,044	866
Miscellaneous	1,835	2,347	*522
Subscribers May 30.			
Monthly	2,176	1,907	269
Rental	\$9,437	\$8,445	\$992

* Decrease.

ANOTHER evidence of the desire of telephone companies to test various means of income is shown in the intention of the Rocky Mountain Bell Telephone Co. to introduce nickel-in-the-slot instruments. The rate will be a monthly rental of \$3 and 5 cents for each connection. Milwaukee has a similar system.

WORLD'S FAIR AWARDS ON WIRE.

WE have received from Prof. Anderson, secretary of the Judges on Electricity at the World's Fair, the subjoined list of awards made on insulated wires; to which are appended the awards for telephone cables and bare electrical wire. No data is ready yet as to the series of tests made.

W. R. BRIXEY. Address, New York, N. Y.
Group 126.—Class 769.
Insulated Wire for Electric Light Service.
AWARD.

- 1st. Highest excellence in insulating qualities.
- 2nd. Durability of insulation under conditions found in commercial service.
- 3rd. Uniform high excellence in mechanical qualities of insulation.

Note.—This report is based upon the results of exhaustive tests approximating the various conditions to be met with in practice by insulated wires in electric light service.

D. C. JACKSON,
Individual Judge.

HENRY S. CARHART,
President Departmental Committee.

OKONITE CO. Address, New York, N. Y.
Group 126.—Class 769.
Insulated Wire.
AWARD.

(a) *Rubber Insulated Wires for Electric Lighting.*

- 1st. High excellence in insulating qualities.
- 2nd. Durability of insulation under conditions found in commercial service.
- 3rd. Uniform high excellence in mechanical qualities of insulation.

Note.—This report is based upon the results of exhaustive tests approximating the various conditions to be met with by insulated wires in electric light service.

(b) *Lead Covered Cable for Underground Electric Light Service.*
This cable has proved successful in commercial service.

D. C. JACKSON.

HENRY S. CARHART.

NEW YORK INSULATED WIRE CO. Address, New York, N. Y.
Group 126.—Class 769.
Grimshaw White Core Insulated Wire.
AWARD.

- 1st. Durability of insulation.
- 2nd. Mechanical excellence of insulation.

Note.—This report is based upon the results of exhaustive tests approximating the various conditions to be met with in practice by insulated wires in electric light service.

D. C. JACKSON.

HENRY S. CARHART.

SIMPLEX ELECTRIC CO. Address, Boston, Mass.
Group 126.—Class 769.
Insulated Wires.
AWARD.

These are good weatherproof wires.

D. C. JACKSON.

HENRY S. CARHART.

STANDARD UNDERGROUND CABLE CO. Address, Pittsburgh, Pa.
Group 126.—Class 769.
Lead Covered Cables for Underground Electric Light and Power Service.
AWARD.

This cable has proven successful in commercial service.

D. C. JACKSON.

HENRY S. CARHART.

NORWICH INSULATED WIRE CO. Address, New York, N. Y.
Group 126.—Class 769.
Lead Covered Cables for Underground Electric Light Service.
AWARD.

This cable has proven successful in commercial service.

D. C. JACKSON.

HENRY S. CARHART.

DEPARTMENT J, ELECTRICITY.
Only Award. 2446.

W. R. BRIXEY. Address, New York, N. Y.
Group 133.—Class 790.
Exhibit.—Telegraph and Telephone Cables, Underground, Aerial and Submarine.
AWARD.

- 1st. Excellence of material and construction.
- 2nd. High insulation.

3rd. Reliability and durability demonstrated by records of prolonged service under exacting conditions.

M. O'DEA,
Individual Judge.

Approved: HENRY S. CARHART,
President Departmental Committee.

J. A. ROEBLING'S SONS CO. Address, Trenton, N. J.
Group 126.—Class 769.
Exhibit.—Bare Copper and Trolley Wire.
AWARD.

- 1st. High conductivity.
- 2nd. Long lengths.
- 3rd. Great tensile strength.
- 4th. Uniform gauge.

M. O'DEA,
Individual Judge.

Approved: HENRY S. CARHART,
President Departmental Committee.

WASHBURN & MOEN. Address, Worcester, Mass.
Group 126.—Class 769.
Exhibit.—Bare Copper Wire.
AWARD.

High conductivity.

This exhibit includes bare copper wire for lighting and power circuits, trolley wires and hard drawn wire for telephone circuits.

B. F. THOMAS,
Individual Judge.

Approved: HENRY S. CARHART,
President Departmental Committee.

In connection with the above awards, the following were the tests made during the World's Fair:

1st Test. Breakdown test, using Westinghouse 2,000 volt alternating current in connection with Westinghouse Step Up Transformer.

2nd Test. Continuous high pressure—6,000 volts—wires run in ordinary water.

3rd or Soak Test. 1st. Solution 10% Sulphuric Acid. 2nd. Solution 10% Ammonia. 3rd. Solution saturated Lime. 4th. Solution subway refuse dissolved in Chicago hydrant water. 5th. Solution Chicago hydrant water.

Time of Test—100 Days.

Ten varieties of wire were in the test. Wires were tested weekly by galvanometer, and the figures recorded for computing the results, and making the awards.

Wires Tested.—Kerite, Okonite, Grimshaw, Simplex, Safety; E. M. W. (General Electric) Paronite, Washburn & Moen Salamander, Washburn & Moen Rubber Covered, Roebling Crescent.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS
ISSUED JULY 31, 1894.

Accumulators:—

Process of Making Secondary Battery Plates, W. L. Silvey, Dayton, Ohio, 523,689. Filed Sept. 22, 1892.

The process consists in immersing anodes and cathodes in a solution containing a combination of acetic acid and potassium, subjecting them to the action of an electric current which oxidizes the anode and deposits it upon the cathode in a metallic state, then removing the cathodes from the depositing bath and compacting the deposit, after which they are placed in a solution of sulphuric acid in water and charged to produce positive electrodes.

Alarms and Signals:—

Railway Signal, F. E. Kinsman, Plainfield, N. J., 523,723. Filed Feb. 1, 1893.

An electric block system for steam railways acting automatically upon the locomotive and providing for the possible failure of the apparatus to work properly when needed.

Electric Signal for Railways, C. A. Hammond, Boston, Mass., 523,767. Filed Apl. 12, 1894.

An automatic electric semaphore system for steam railways.
Means for Testing Electric Signal Boxes, J. F. Mehren, Chicago, Ill., 523,798. Filed Nov. 24, 1893.

Electric Signaling Apparatus for Railway Trains, W. H. Baker, Pawtucket, R. I., 523,847. Filed May 31, 1894.

Employs the air brake connections to complete an electric circuit between the cars and the engine cars.

Conductors, Conducts and Insulators:—

Insulating Block, H. P. Ball, Bridgeport, Conn., 523,653. Filed May 21, 1894.

A guard wire block formed in sections so constructed as to be held from slipping upon each other.

Distribution:—

Electric Converter, J. A. Cabot, Cincinnati, O., 523,805. Filed Sept. 22, 1893.

Employs a shell consisting of soft metal plates all pierced with cruciform slots, and a number of detachable cores inserted within the slots.

Dynamoes and Motors:—

Commutator for Dynamo Electric Machines, J. Hoffman, Schenectady, N. Y., 523,663. Filed Dec. 21, 1893.

Claim 4 follows:

As a new article of manufacture, a commutator segment for a dynamo-electric machine, having insulating material firmly adherent thereto.

Dynamo Electric Machine or Motor, W. H. Knight, Lynn, Mass., 523,668. Filed Jan. 9, 1894.

Employs a method of equalizing the potential of the armature which consists of varying the magnetism of the poles in greater proximity to the armature proportionately to the increased electromotive force generated therein by such approximation.

Armature for Dynamo Electric Machines, H. G. Reist, Lynn, Mass., 523,635. Filed Sept. 15, 1893.

The invention relates particularly to the winding of armatures designed to generate or respond to currents of large quantity and low potential.

Dynamo Electric Machines, E. Thomson, Swampscott, Mass., 523,696. Filed March 19, 1894.

Employs a method of equalizing the potential of the current in the armature which consists in strengthening the inductive action of the weaker poles by current taken from the part of the armature generating the higher potential.

Armature for Dynamo Electric Machines, H. F. Parshall, Lynn, Mass., 523,776. Filed Jan. 31, 1894.

Employs a core comprising bundles of annular laminæ separated from one another and provided with transverse channels.

Alternating Current Generator, E. W. Rice, Jr., Swampscott, Mass., 523,779. Filed July 25, 1893.

Relates to the compounding of two phase alternating generators to maintain constant potential at the translating devices under variations of load.

Galvanic and Thermo-Electric Batteries:—

Galvanic Battery, C. E. Buell, North Plainfield, N. J., 523,758. Filed Dec. 24, 1893.

A gravity battery consisting of a vessel charged with undissolved sulphate of copper and water, and provided with a copper electrode and an iron electrode.

Galvanic Element, A. Hell, Crumbach, Germany, 523,802. Filed Sept. 27, 1893.

Consists of a negative electrode attached to a support made of a base metal, a depolarizing compound inclosed in a bag together with the electrode, and a felt diaphragm surrounding the bag and separating it from the positive electrode.

Lamps and Appurtenances:—

Bushing for Electric Arc Lamps, T. J. Houck, Baltimore, Md., 523,967. Filed Apl. 23, 1894.

Electric Arc Lamp, J. B. McKeown, Cleveland, O., 11,433, Reissue. Filed May 1, 1894.

Relates to certain details of construction of the feeding mechanism and of the method of supporting the lower carbon and the globe.

Measurement:—

Electric Meter, E. Hartmann, Frankfurt-on-the Main, Germany, 523,662. Filed Mch. 23, 1893.

A wattmeter for continuous or alternating current in which the indications are transmitted at intervals to counting mechanism.

Electric Meter, T. Duncan, Fort Wayne, Ind., 523,704. Filed Mch. 14, 1894.

Employs inducing coils, an aluminum revolvable secondary armature, and an adjustable diverter having short circuited coils placed upon its poles, for determining the speed and direction of rotation of the armature.

Testing Device for Electric Circuits, G. A. O'Neill, Boston, Mass., 523,865. Filed Oct. 20, 1893.

Metal Working:—

Electric Welding or Brazing Mechanism, G. D. Burton, Boston, Mass., 523,967. Filed June 3, 1893.

The invention relates to welding by the direct application of the electric arc.

Miscellaneous:—

Electric Expansion Device, E. Thomson, Swampscott, Mass., 523,691. Filed Nov. 23, 1893.

Employs a closed receptacle filled with expansible liquid and having a yielding side, a heating coil about the receptacle, and a non-conducting cover inclosing the whole.

Arc Rupturing Device, G. T. Voorhees, Boston, Mass., 523,697. Filed May 8, 1893.

Electromagnetic Reciprocating Pump, C. J. Van Depoele, Dec'd, Lynn, Mass., C. A. Coffin and A. Wahl, Administrators, 523,882. Filed Dec. 12, 1891.

Fluid Pressure Device, C. H. Veeder and E. D. Priest, Lynn, Mass., 523,873. Filed Jan. 6, 1894.

Bank Safe, D. M. Rothenberger, Lancaster, Pa., 523,946. Filed May 17, 1893.

The invention consists in surrounding the safe or other inclosure with a compressed air chamber, in combination with means for sounding an alarm by reducing the air pressure.

Switches and Out-Outs:—

Automatic Circuit Closer, J. W. White, Providence, R. I., 523,701. Filed March 11, 1893.

Electric Switch, G. E. Linton, Worcester, Mass., 523,724. Filed March 22, 1894.

Relates to the special construction of the contact portion of jack knife switches.

Automatic Line Discharger, J. F. Ganduxer, Gracia, Spain, 523,889. Filed Nov. 4, 1893.

An automatic device adapted to discharge a line upon the passage of an abnormal current.

Telephones and Apparatus:—

Magnetic Telephone, F. H. Brown, Chicago, Ill., 523,927. Filed Nov. 25, 1893.

A magneto telephone especially designed to relieve the magnetic stress upon the diaphragm.

REPORTS OF COMPANIES.

THE RIES ELECTRIC SPECIALTY COMPANY.

THE Ries Electric Specialty Company, of Baltimore, Md., has made application for the appointment of a receiver to take charge of and wind up the business of that company. Mr. Elias E. Ries, the president of the company, stated that the corporation is unable to prosecute its business successfully, owing chiefly to internal dissensions among some of its stockholders, and that the assets of the company are, therefore, in danger of being wasted to the prejudice of the creditors. Hence the petition for a receiver, who was appointed last week, for the purpose of dissolving the corporation and making an equitable distribution of the assets among the creditors and shareholders. The company was incorporated on June 16, 1890, and has been engaged in the manufacture and

sale of several well-known electrical specialties, including the Ries regulating sockets for incandescent lamps. The company has a well-equipped manufacturing plant, occupying the entire building at No. 7 South Gay street, and owns a number of valuable patents and other property. It is the intention of Mr. Ries to reorganize the company and to take up the introduction, under more favorable auspices, of some inventions recently perfected by him, in addition to the specialties heretofore controlled by the company, and for which it is expected there will be a large demand.

LATEST W. U. ACQUISITION.

The increase in the listed Western Union stock of \$550,000 has been made in consequence of the acquisition of the American Rapid Telegraph Company. This company had \$3,000,000 stock and \$3,000,000 bonds. It was recently sold under foreclosure and was bought by a committee of bondholders and subsequently sold to the Western Union Company.

SOCIETY AND CLUB NOTES.

CONVENTION OF THE ASSOCIATION OF EDISON ILLUMINATING COMPANIES.

The next Convention of the Association of Edison Illuminating Companies will be held at Boston, Mass., commencing on Tuesday, August 14th, 1894, and will continue during Wednesday, and probably Thursday of that week.

Reports of Committees chosen at the meetings of last year will be made, and the following papers of practical importance submitted:

Incandescent Lamps—(Mr. A. D. Page.) The Relative Advantages of Direct and Alternating Currents for Distribution of Light and Power—(Mr. W. L. R. Emmet.) A Board of Control—(Prof. Wm. D. Marks.) An Edison Station in a Small City. Its Past, Present, and Future—(Mr. M. A. Beal.) Switchboard of the Edison Company of New York—(Mr. J. Van Vleck.) Storage Batteries—(Mr. R. R. Bowker.) Boiler Tests in Atlantic Avenue Station of the Edison Electric Illuminating Company of Boston—(R. S. Hale.) Interesting Features of the Third District Station of the Edison Electric Illuminating Company of Boston—(A. G. Pierce.) Low Tension Arc Street Lighting System—(Mr. W. S. Barstow.)

The headquarters and meeting place of the Association at Boston, will be at the "Vendome."

The Edison Electric Illuminating Company of Boston (Mr. C. L. Edgar, Vice-President and General Manager), has arranged a very attractive programme for the entertainment of delegates in the form of drives through the beautiful suburbs of Boston, probably the finest in the world. Visits will also be made to the West End Station of the Boston Street Railway System, and to the various Edison Stations in Boston, where can be seen the latest type of central station equipments, including the recently installed central station storage battery, lately described by Mr. A. C. Shaw in THE ELECTRICAL ENGINEER, now in successful every-day operation.

The General Electric Company will have present one or more of their officers and engineers, and have extended an invitation to the members of the Association to visit the Lynn Works and join them in a dinner at Marblehead Neck, the great rendezvous for all yacht club races. During the Convention sessions a special entertainment will be provided for ladies accompanying members. The Edison Electric Illuminating Company of Boston have provided entertainment for all members who may find it possible to reach Boston on Monday evening, Aug. 13.

THE SOCIETY OF HEATING AND VENTILATING ENGINEERS.

An important engineering movement was set on foot at an informal but well attended meeting of those interested in heating and ventilation, at the offices of Power, World Building, New York, on August 2. The object was to see whether a society devoted to such work should not be organized; and, after discussion, a committee on organization was appointed as follows: F. P. Smith, C. E.; A. A. Cary, of Abendroth & Root; H. J. Barron, of the Barron Steam Heating Co.; James Harding, superintendent of the Boynton Furnace Co.; W. M. Mackay, manager of Hart & Crouse. This excellent committee is to report about the middle of September, when proper steps to organize the society will be taken, on the general lines followed by engineering and technical bodies. The Society will address itself to the work of eliciting papers and discussions, and of standardizing the now contradictory views and practice prevalent in both of the fields it will represent. Mr. Smith has been appointed to act as chairman of the committee. This movement is one of interest to many electrical engineers, especially those who have taken up the newer branches of electric heating and electrical ventilation. The new Society should prove a welcome addition to the engineering bodies of the country, having a distinct and unoccupied, but very important, territory peculiarly its own.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE MATHER MULTIPOLAR GENERATOR.

THE accompanying illustration shows the improved 250 H. P. generator manufactured by the Mather Electric Company of Manchester, Conn. One peculiar advantage claimed for this type of generator is that on account of the fields being cast in four pieces, and entirely separate from the frame, all being bolted together, the assembling or taking apart of the generator to allow of the removal of the armature is accomplished in an exceedingly short time and with the greatest ease. These generators are designed to be belt driven or direct connected to the shaft of the engine, and, being reversible on their bed plates, can be run in either direction at will, by making a slight change in the connections. They are self-oiling, self-exciting, self-regulating, and, after being started, completely self-attendant. The multipolar generators are all compound wound and entirely self-regulating, and equally well adapted for electric lighting, electric railway or power purposes.

The railway generators are wound for a nominal voltage of 500,

to their appearance. They are all standard machines and any part can be duplicated at once.

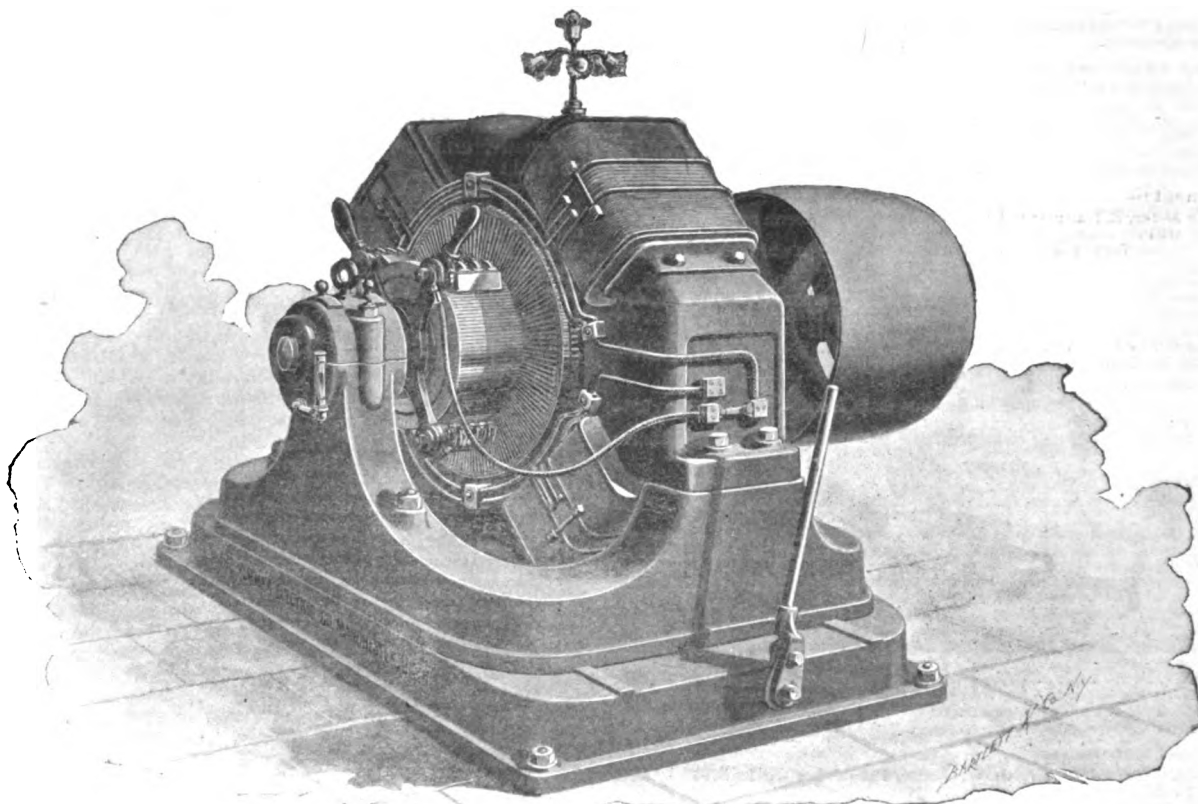
The present range of these generators is up to 250 H. P., as stated above, and down to 30 K. W., but the Mather Company propose to carry this type into units as high as 500 K. W. In such machines, there will be six poles instead of the four in the smaller sizes.

A BEAUTIFUL ELECTRIC LAUNCH FOR CONGRESSMAN SORG.

THE GENERAL ELECTRIC LAUNCH CO., of Morris Heights, New York City, has just finished and launched a very fine boat for Congressman Sorg, of Ohio. Her dimensions are:

Length over all.....	47 ft.
Water line.....	48 " 3 in.
Beam.....	7 " 6 "
Draft.....	2 " 1½ "

The frame is of oak; the hull, decks and cabin of polished mahogany; deck fittings, rails, etc., of brass. It has a double screw propeller, equipped with two 4 h. p. motors, and 186 cells of storage battery.



MATHER MULTIPOLAR GENERATOR.

but, having a rheostat in the field circuit, the potential can be raised to 600 volts without undue heating, and even 50 per cent. overloads will be borne for short periods without injury to the machine.

One of the tests to which the Mather Company subjects these generators is to throw on or off heavy loads, always leaving the brushes in the same position. No sparking is caused even by a current in excess of the rated capacity of the machine, and it is said to be impossible to distinguish by watching the brushes whether the generator is loaded or not.

The bearings of these generators are self-oiling. Automatic alignment is secured by the use of ball bearings, which adjust themselves and can never bind on the shaft. The supports for the bearings and the entire bed plate are cast in one piece, a construction which gives great strength and rigidity to the bearings, and secures great freedom from vibration.

There are four sets of brushes, each brush held in an independent holder, hence any single brush can be raised from the commutator without disturbing the others, and, each having its own spring, may be perfectly adjusted. The diametrically opposite brushes are of the same polarity and are connected. The rocker arm of the brush holder is of rigid construction and the different parts are perfectly insulated; it is designed so that it will adjust all the brushes simultaneously.

These generators, whether for lighting or power purposes, are each furnished with a handsome electrolier, thus adding greatly

The cabin roof extends the full length of cock-pit; cabin proper being 17 ft. long, and furnished with lavatory, ice-box, stove, etc. It is upholstered in silk plush corduroy, with curtains of pea green damask.

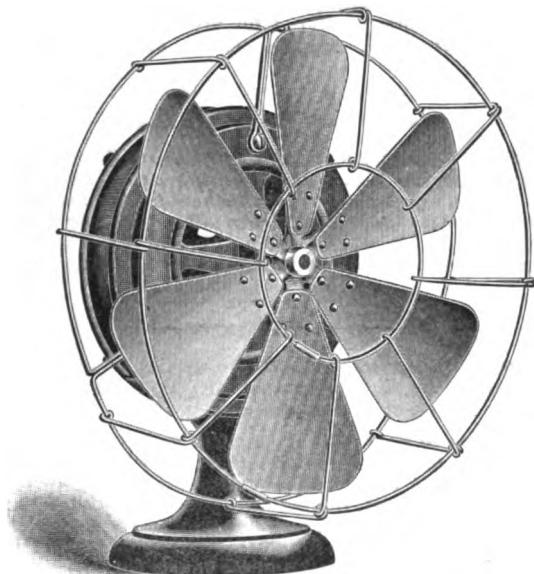
The normal rate of speed is 1 mile in 7 minutes; maximum rate 1 mile in 5 minutes. The boat is to be used on Lake Chautauquau. While the launch is fitted throughout with an eye to the greatest comfort and luxury, yet the lines of the hull indicate at a glance that it is built for the best speed obtainable by a boat of its size. It is probably the handsomest electric launch ever constructed.

HARTMAN & BRAUN'S NEW CATALOGUE.

MESSRS. HARTMAN & BRAUN, of Bockenheim-Frankfort a. M., have issued their 1894 illustrated catalogue, containing 156 pages, profusely illustrated with well-executed wood cuts of their apparatus, among which may be specially mentioned their direct reading ohmmeters and wattmeters. The book is beautifully bound and well printed, while the subject matter is concise, but sufficiently full to clearly describe the apparatus to which it refers. The first few pages are taken up with a brief account of the firm's exhibit at the Fair last year, a full description of which appeared in THE ELECTRICAL ENGINEER of July 19, 1893. The more important of the apparatus mentioned in the catalogue was also described in the article referred to.

GENERAL ELECTRIC ALTERNATING FAN MOTOR.

The extreme summer heat which is upon the country—the worst in 20 years—has turned the mind of every man fortunate enough to live, or have his office, in a building where electricity has been installed, to the pleasant artificial breezes created by the fan motor. The General Electric Company has just perfected such a motor for alternating circuits. It is small and compact, and is constructed for any alternating current circuit of 52 or 104 volts.



GENERAL ELECTRIC ALTERNATING FAN MOTOR.

The armature or moving part is nothing more than a solid metal wheel hung on one bearing. It has no wires at all, no brushes, no commutators, no collecting rings, in fact no contact parts at all to cause trouble. The current from the transformer enters only a number of stationary field spools which cannot burn out, and which are entirely enclosed and protected. The fan is 10 inches in diameter, has six blades and is protected by a polished brass guard. It starts as soon as the current is thrown on and runs at 1,800 revolutions, giving quite a powerful and cooling breeze. The height of the motor and fan over all is only twelve inches. It is finished in black japan.

A LARGE NEW FORT WAYNE ALTERNATOR.

At the works of the Fort Wayne Electric Corporation there is running and being tested at the present time a new alternating current dynamo. This dynamo is the last of a series of iron-clad alternators designed by Mr. James J. Wood, the company's electrician. This alternator as recently noted in these pages, has the largest capacity of any single armature, compound wound alternator ever constructed in this country, having one-fifth larger capacity than the big alternators exhibited at the Chicago Exhibition. The machine from the first has worked beautifully, and in every particular is more than meeting the expectation of the designer; while so far as the workmanship is concerned, it reflects great credit upon the workmen who constructed it. The design is beautifully artistic embodying the beautiful lines and curves exhibited in all of Mr. Wood's apparatus, while the efficiency is considerably over 90 per cent. It is capable of operating 6,000 16 c. p. lights, and some idea of its size will be realized from the following dimensions: It is 16 feet long, 8 feet wide and 10 feet high, while it weighs 81,000 pounds, producing a current of 150 amperes at 2,900 volts, requiring an engine of 600 H. P. to drive it.

"N. I. R." WIRES AND CABLES.

The National India Rubber Co., of Bristol, R. I., has just issued a very complete catalogue giving a detailed description of many different kinds and sizes of electric conductors designed for ordinary requirements, though the company is prepared to furnish special work for any reasonable conditions, and, in fact, has had considerable experience in the latter direction. The catalogue consists almost entirely in concise and carefully compiled tables giving the various sizes of conductors, which are listed with three thicknesses of insulation to enable purchasers to select the one best suited to their peculiar needs. They are calculated for voltages of 1 to 1,000, 1,000 to 2,000 and 2,000 to 5,500, respectively.

The "N. I. R." seamless insulation has very high insulating qualities and withstands to a remarkable degree the destructive effects of heat, cold, moisture and gases. The best Para rubber is used, and the company's 80 years of experience in the rubber business, together with the high class of skilled labor employed insures the production of an insulation that has been found

excellent after the most severe tests. No wire is sent out from the factory that fails to come up to a very high standard of insulation resistance, and where wires or cables are intended for special work they tested in the company's laboratory under conditions as nearly as possible identical with those to be met in practice.

The following letter shows the result of a test of double conductor "N. I. R." cable for the Government service, and speaks for itself.

AFTER ONE MONTH'S IMMERSION IN SALT WATER.

The double conductor cable submitted by the National India Rubber Co., Bristol, R. I., has been tested and is satisfactory. The resistance of the insulation is, 2,270 megohms per knot.

The cable was further tested by cutting off about ten feet and about 800 lbs. hung to it, then knots were tied in it; it was twisted up tight and kinks made in it and hauled taut. In one kink the outside braiding was torn, but it was impossible to tear it again, though it was particularly tried.

After this handling this piece was put in a barrel of water and tested for continuity and leaks. No injury seemed to have been done to the wires or insulation. The copper wires are tough and pliable and the fining seems to be well done.

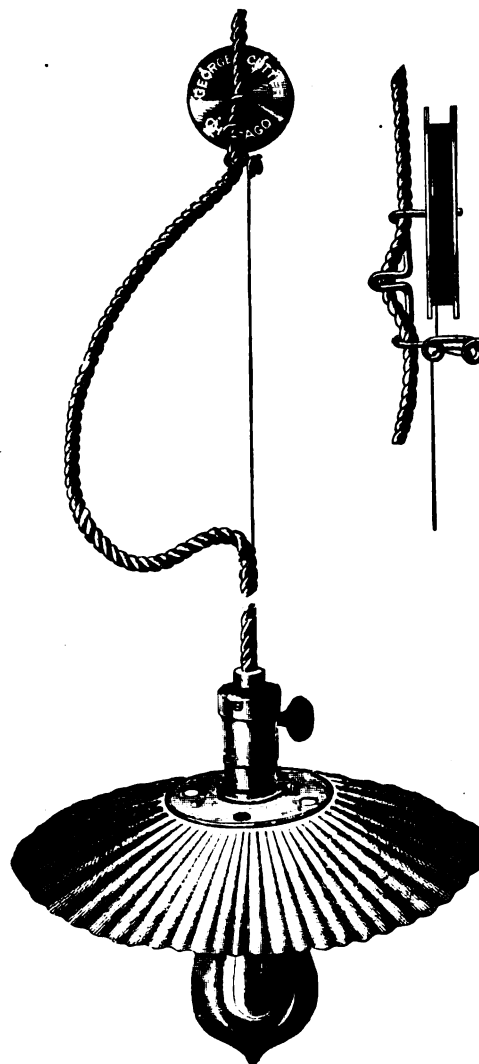
Respectfully,

DUNCAN KENNEDY,
Lieut. Comdr., U. S. Navy.

NAVAL TORPEDO STATION, NEWPORT, R. I., March 19, 1894.

CUTTER'S CORD ADJUSTER.

THIS new arrival among the automatic devices for adjusting the height of drop lights is one of the simplest and neatest of them all. It is small and compact, being only twice the size shown in the smaller of the accompanying illustrations, and the



CUTTER'S CORD ADJUSTER.

ingenious arrangement of the fastening allows it to be put in place in half a minute without the use of tools. There is no need of disconnecting the cord from the rosette or socket, nor for coiling up the lamp cord, as is the case with the older forms. Still it takes up enough slack in the cord to meet the common requirements, and holds the lamp and shade securely at any point within its range. It is made by George Cutter, of Chicago, and will doubtless meet with ready appreciation.

A GENUINE ELECTRIC HAIR BRUSH.

The Nassau Electric Company of 106 Liberty street, New York city, has recently introduced an electric brush that is an electric brush. It depends for its action not upon the credulity of the public but upon an actual battery and induction coil, and gives a current that must be felt to be thoroughly appreciated.

The brush, as shown in the accompanying illustration, is made of the best material and finished by labor of the highest class; it is either a hair brush for ordinary purposes or a therapeutic instrument. It contains the complete equipment of the most recent and approved form of medical battery, operated by a chloride of silver Nassau "Challenge" cell of 1.10 volts, which can be started or stopped by pressing a switch, between hand and cover, to left or right. It is claimed to have a life of over a year in ordinary use, after which, all that is required is to renew the cell. The cell is shown full size in the upper illustration. Its elements are chloride of silver and zinc, and being hermetically capsule-sealed, it combines the efficiency of the best form of wet



ELECTRIC HAIR BRUSH AND BATTERY.

battery, with the freedom from waste and trouble usually found only in a dry cell. It is simple and powerful, and is used for every industrial purpose where a battery is required. Its dimensions and E. M. F. permit its application to this brush, which is probably the first bona-fide electro-medical brush ever placed before the public.

SALES OF HARRISBURG IDEAL ENGINES.

W. R. FLEMING & Co., representatives of the Harrisburg Foundry & Machine Works in New York and New England, have handed us a list of engines and engineering work which they have taken contracts for since May 1st. Considering the dullness and general depression in business and the undoubted decrease in the bulk of general trade, the record is quite remarkable.

One 200 h. p. Ideal tandem compound engine direct connected to Siemens-Halske generator for the Broadway Cable Road; two 40 h. p. simple engines for friction driving Thomson-Houston dynamos for the new 250,000,000 candle power lamp, Fire Island Light House; one 60 h. p. Ideal engine for "Stevens" apartment house, New York; two 100 h. p. Ideal engines direct connected to 50 K. W. General Electric dynamos for new hotel, cor. 73d St. and Boulevard, N. Y. City; One 60 h. p. standard Ideal engine for the American Tobacco Co., New York; Four Ideal engines aggregating 500 h. p. arranged for direct connection to General Electric dynamos for the hotel "Jefferson," Richmond, Va.; one 40 h. p. standard Ideal engine, boiler and complete steam plant for Messrs. Kibbe & Co., Hartford, Ct.; one 60 h. p. standard Ideal engine for electric sewerage purification for the city of Danbury, Conn.; two 60 h. p. Ideal engines arranged for direct connection to General Electric apparatus for the new City Hall at Brockton, Mass.; one 70 h. p. standard Ideal engine for the Bangor S. S. Co., Boston, Mass.; two 40 h. p. standard Ideal engines for the steamships just built for the Old Dominion S. S. Co.; one 70 h. p. Ideal engine for "Lyceum" Theatre, Boston, Mass.; one 80 h. p. Ideal engine for the Oakland Paper Co., Manchester, Ct.; one 60 h. p. Ideal engine (8d order) for the Nichols Chemical Co., N. Y. City; two 100 h. p. Ideal engines for the electric plant of the U. S. Post Office, Brooklyn; one 150 h. p. engine, boilers and complete steam plant for export to Havana, Cuba; one 50 h. p. Ideal engine for the Brooklyn Elec. Equipment Co., Brooklyn, N. Y.; two 80 h. p. direct connected engines for the N. Y. Electrical Equipment Co., N. Y. City; one 50 h. p. Ideal engine, boiler and complete steam plant for Anson W. Burchard, M.E.; one 150 h. p., two 100 h. p. and one 60 h. p. Ideal engines for the General Electric Co., New York; one 70 h. p. Ideal engine, Mr. Chas. N. Knox, Hartford, Ct.; one 50 h. p. standard Ideal engine, Mr. John B. Herreshoff, M.E., New York; one 10" x 10" Ideal engine for the Atlanta Water Works, city of

Atlanta, Ga.; two 100 h. p. standard Ideal engines, Morrison Southern Const. Co., Baltimore, Md.

The contract has also been awarded to W. R. Fleming & Co., for supplying all the equipment of the complete electric central lighting and power station plant for Port of Spain, Island of Trinidad, West Indies. This plant consists of four 250 h. p. tandem compound Ideal engines, four high duty steel horizontal tubular boilers with Weitmeyer furnaces, two 2,000 light incandescent dynamos, two 50 arc machines, one 100 K. W. railway generator. The entire equipment of this plant is in the hands of Messrs. W. R. Fleming & Co., who are to erect it and turn it over to the owners, an Anglo-American syndicate, in complete operation.

ACCIDENT TO C. H. RUDD.

ONE of the electrical staff of the Western Electric Company, Mr. C. H. Rudd, has been experimenting lately in the vicinity of Chicago with a new explosive, whose action is said to be based on the sudden generation of heat electrically. On July 31, an explosion occurred at his works, when three of his assistants were killed, and he and two other persons were badly injured.

NEW YORK NOTES.

THE PECKHAM MOTOR TRUCK & WHEEL CO., of 1,006 Havemeyer Building, this city, notify us that Mr. P. S. Bemis, Jr., is no longer their representative at Chicago.

THE STANDARD PAINT CO. have lately had considerable success with their "P. & B. Ruberoid Roofing," in which the absence of one "B" is atoned for by an abundance of high weatherproof, acid proof, alkali proof, temperature proof, and other good qualities. It contains no tar. It has been used at the Roebling Works, among other places, and is found there to be most eminently satisfactory. A number of testimonials vouch for its merit.

"KERITE" TRIUMPHANT. Mr. W. R. Brixey, proprietor of Day's "Kerite," has received with much pleasure the announcement of the award made to him by the World's Fair judges. Not only has he carried off the highest award, but he has won the only medal given for insulated wires, although some ten were put under scrutiny and test. This is a good record, after being on the market half a century. Mr. Brixey directs attention not only to the well-known technical standing of the judges but the severe nature of the tests that had to be undergone. Such trials would develop mercilessly the defects of any insulation, and hence the wire that could best withstand such an ordeal needed little other recommendation. The verdict of Prof. S. F. B. Morse thus found itself repeated at the World's Fair, and with it "Kerite" goes forward on another half century of success and prosperity.

WESTERN NOTES.

MR. CARL K. MACFADDEN has returned from an extended trip along the North Shore of Lake Superior, where, accompanied by Mrs. Mac Fadden, he spent some weeks enjoying a well-earned vacation.

MR. CHARLES E. SHARP, General Manager of the Southern Electrical Supply Company, St. Louis, had a short business trip to Chicago last week. Mr. Sharp reports business as slightly improving in the south.

TAYLOR, DEE & MACK, Chicago, among other specialties, are carrying a complete line of arc lamps for direct and alternating incandescent circuits, Solar carbons and station switches of all styles and capacities.

THE MANY FRIENDS of the Messrs. McKinlock will be sorry to hear of the death of their mother, wife of Capt. John McKinlock, which occurred in Chicago the 29th ult. THE ELECTRICAL ENGINEER extends its sympathy to the McKinlock family.

THE UNDERWRITERS' INTERNATIONAL ELECTRIC ASSOCIATION, through its committee on Fires, Mr. Wm. H. Merrill, Jr., is publishing its fourth report of the Committee on Fires. The report is as usual, interesting and instructive, containing a list of 123 cases of fires or damage caused by electricity. The list is too long to give entire and comprises almost every conceivable cause of fire. These are sparks from arc lamps, crosses between electric light and telephone wires, burned out converters, overheated rheostats, burn out in motor and so on. In almost every instance the damage could have been prevented, it seems, by better construction or more careful inspection.

Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE Electrical Engineer.

Vol. XVIII.

AUGUST 15, 1894.

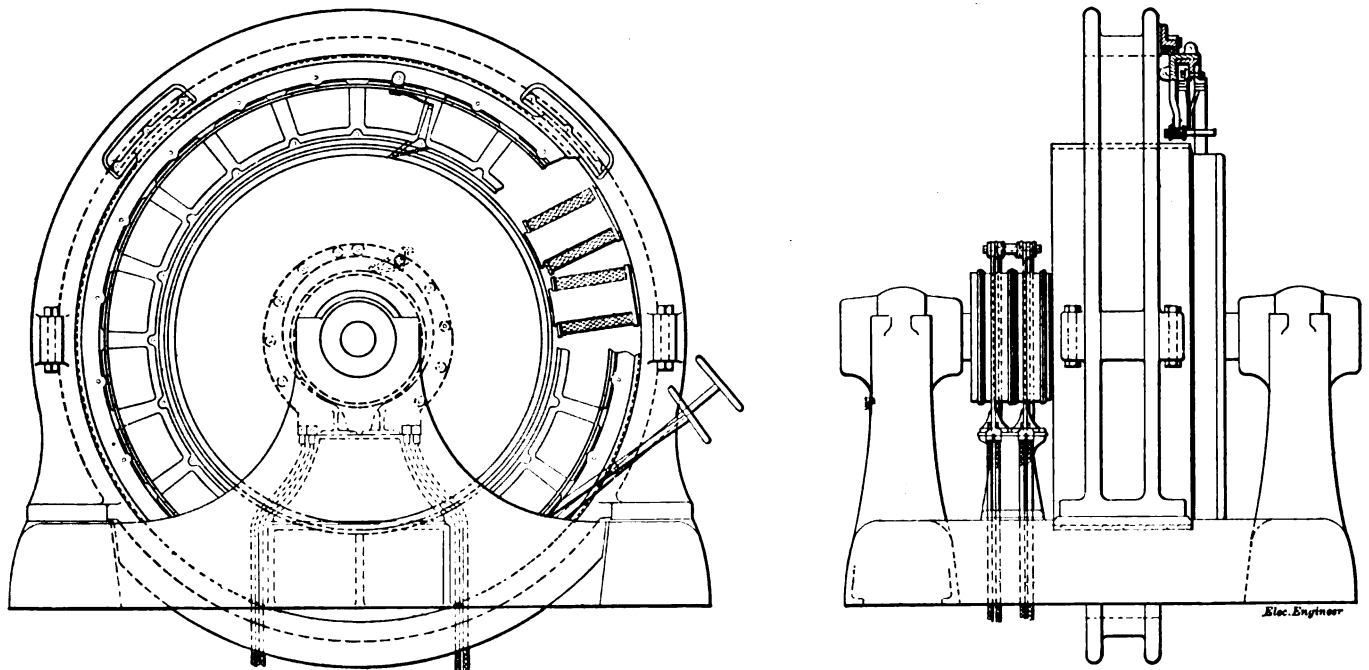
No. 328.

THE PITTSBURGH REDUCTION CO.'S ELECTRIC PLANT AT NIAGARA FALLS.

AS our readers are aware the Cataract Construction Company at Niagara Falls, have adopted the plan of generating current primarily at 2,000 volts, alternating, at 25 cycles per minute, on the two phase system. Where the distance to which electric power is to be transmitted is beyond the limits of Niagara Falls this potential is raised by step-up transformers to the desired E. M. F.; but for Niagara and vicinity the 2,000 volts delivered directly from the machine will be furnished to consumers, at whose premises it will be transformed to any potential and character desired. Among those who have already arranged to trans-

ference of about 2,500 feet. Here it is led into the static transformers and is reduced to 115 volts alternating. This current is then led to the rotary transformers which convert it into continuous current at 160 volts.

Our illustrations, Figs. 1 and 2 show the rotary transformer in front and side elevations. As will be seen, the low tension alternating current coming from the static transformers at 115 volts, enters at the collector side (shown at the left in Fig. 2) and passes to the transformer armature. Wound on the same armature are the coils in which the continuous current is generated, which is taken off by brushes from the commutator, shown at the right in Fig. 2. The rotary transformer has 20 poles and runs at 150 revolutions per minute, being driven as a



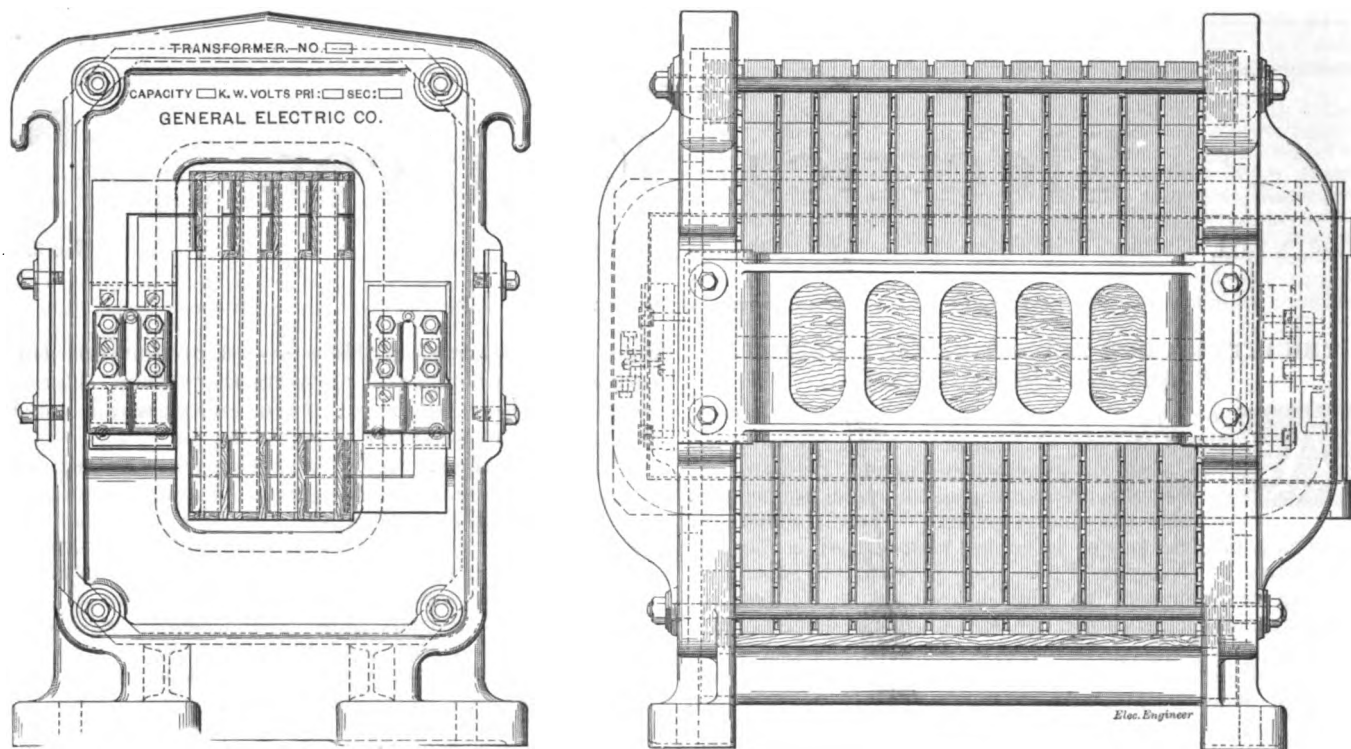
FIGS. 1 AND 2.—ROTARY TRANSFORMER AT THE PITTSBURGH REDUCTION CO.'S ELECTRIC PLANT, NIAGARA FALLS.

fer their works to Niagara is the Pittsburgh Reduction Company, the well-known manufacturers of aluminum. This company has contracted for 1,200 kw. of electrical energy to be delivered in the form of continuous current, which they require for the reduction of the aluminum. The contracts for the electrical apparatus and the fittings to furnish 7,000 amperes at 160 volts, as announced by us at the time, were awarded to the General Electric Co. early in the year, and a recent visit to the works at Schenectady, show it to be rapidly nearing completion.

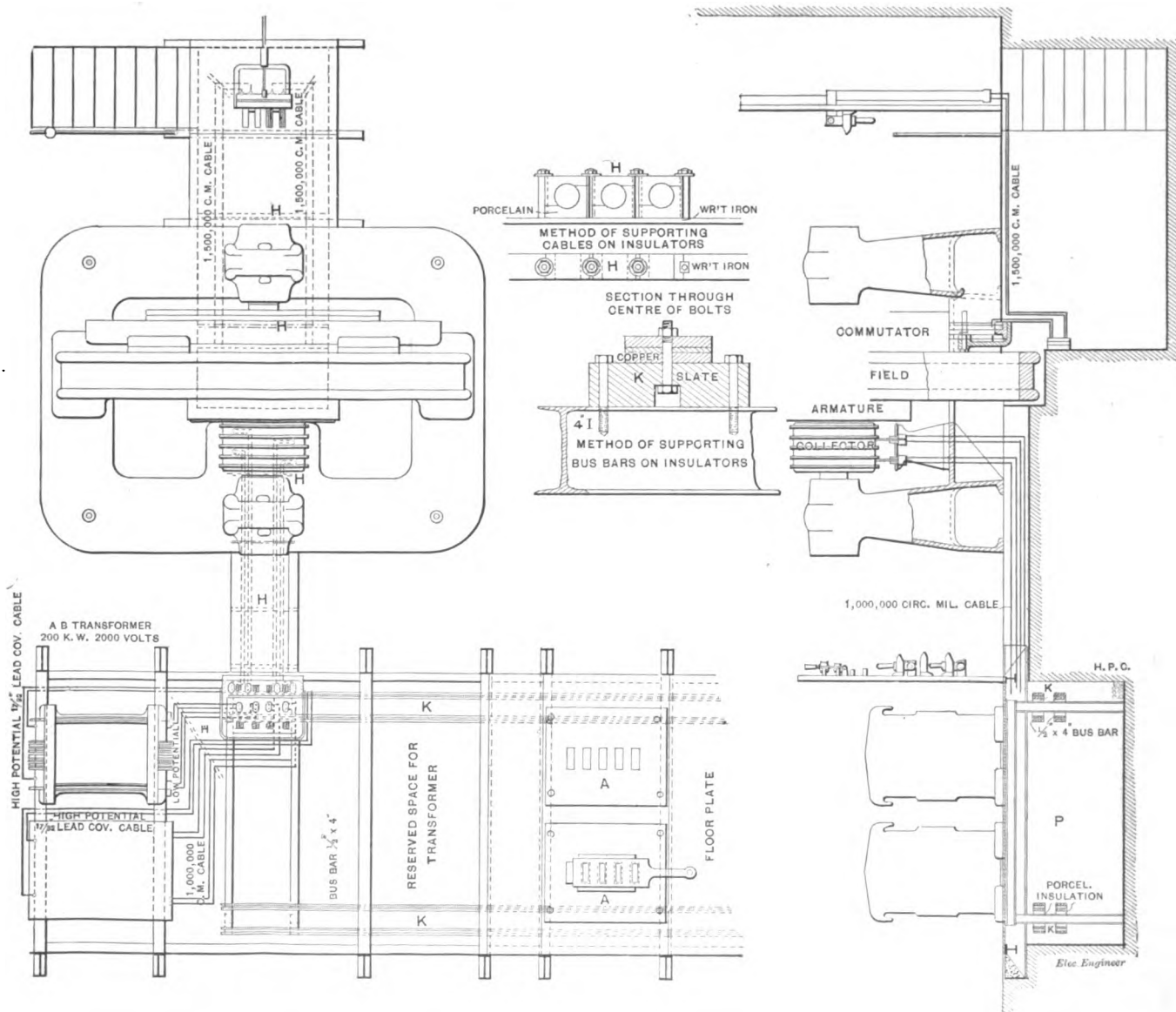
In order to carry out the conversion of the primary alternating current, into the continuous current, rotary transformers in connection with stationary or "static" transformers, as they are called, to distinguish them from the rotary, have been adopted, the system of conversions being as follows: Starting with the 2,000 volt alternating current at the main generating station the current is led to the works of the Pittsburgh Reduction Company, a dis-

quarter phase motor, and having 400 kilowatts capacity. Each such transformer delivers 2,500 amperes continuous current at 160 volts. The diameter of the armature is 90 inches and the machine stands 11 feet 6 inches high, the circular magnetic frame extending a short distance below the floor line. The machine occupies a floor space of 13 feet 6 inches by 9 feet 10 inches in diameter. The combined efficiency of the rotary transformers with that of the stationary is guaranteed at 94½ per cent. and the variation in E. M. F. between full load and no load is limited to 5 per cent. maximum.

The static transformers, of which there are two to each rotary, have been designed with great care in order to fulfill the exacting requirements of the specifications. These call for an efficiency of 97 per cent. at full load and a temperature limit of 40 degrees C. rise above the surrounding air for a continuous run. In order to fulfill these conditions the transformers have been designed so as to



FIGS. 3 AND 4.—STATIC TRANSFORMER AT THE PITTSBURGH REDUCTION CO.'S ELECTRIC PLANT, NIAGARA FALLS.



FIGS. 6, 7, 8 AND 9.—PLAN AND SECTION OF PITTSBURGH REDUCTION CO.'S ELECTRIC PLANT AT NIAGARA FALLS, WITH DETAILS.

admit of thorough ventilation, which is provided for by forcing air through them in the manner which will be described more fully below. For this purpose the transformers (one of which is shown in side and front elevation in Figs. 3 and 4) are built up of laminated sheets in the usual way, but instead of being bolted into one solid mass the laminations are divided up into sections, through which air is forced from below. In order to show the influence of the air ventilation upon these converters we give in Fig. 5 a series of curves representing the result of a test made at Lynn on these transformers. The curves A and B are calculated from resistance measurements. Curve A gives the primary temperature when run without air blast, while curve B gives the primary temperature when run with an air blast of 1,040 cubic feet per

dimensions of the iron core of the transformer are $27 \times 39\frac{1}{2} \times 53$ inches, and each transformer occupies a floor space of $36 \times 52\frac{1}{2}$ inches.

The building in which the apparatus will be set up measures 50 by 87 ft., and this will be equipped with four transformer units, each capable of delivering 500 H. P. in continuous current. Three of these will be in active service, with one as a reserve, thus giving a working capacity, without the reserve, of about 7,000 amperes at 160 volts.

The general arrangement of the apparatus in this building is shown in part plan and vertical section in Figs. 6 and 7. The high potential current coming from the generator at the Falls at 2,000 volts is carried in lead-covered cable through a pit P, 3 ft. deep and 8 ft. wide, which runs the whole length of the building and over which the

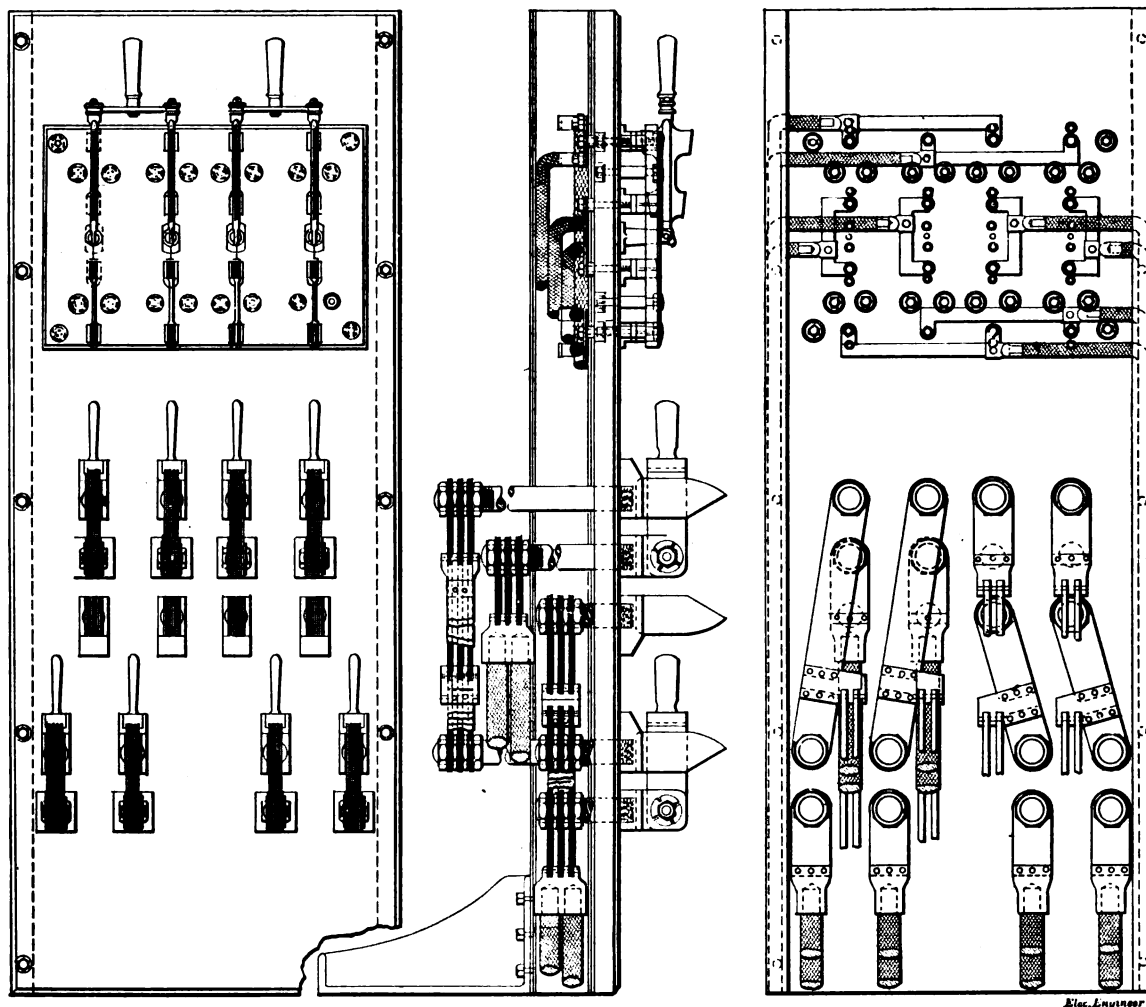


FIG. 10.—DISTRIBUTING SWITCHBOARD, PITTSBURGH REDUCTION CO.'S ELECTRIC PLANT AT NIAGARA FALLS.

minute. Curve C gives the temperature of the air as it issues from the top of the transformer after having passed through it. The point D on curve C gives the temperature of the laminations after 7 hours' run with the air blast. The temperature of the room was 24 degs. C. These curves were plotted from tests made on two 200 K. W. transformers.

It will be noted that by the aid of the air blast the temperature of the transformers reaches a maximum of about 61 degs. C. after about 9 hours' run, while the maximum reached without air blast is 92 degs. C. after 7 hours' run.

Each of these static transformers has a capacity of 200 K. W. The primary takes the current coming from the main power station at 2,000 volts alternating, and transforms it to 115 volts at the secondary terminals. The

static transformers are mounted. These cables are indicated at the right hand lower corner of the pit. They are $\frac{1}{2}$ inch in diameter each, lead-covered to 1 inch, and are divided into four circuits, two for each side of the two-phase system employed. They run through the pit to switchboards where they are connected to the transformers by double throw switches. The low potential side of all converters is connected through double throw switches to bus bars running the entire length of the pit, shown at K; these bus bars are $\frac{1}{2}$ by 4 inches and are mounted on insulators in the manner shown in detail in Fig. 9.

The converters are mounted in pairs over the pit, and, as stated above, are specially designed for air ventilation. To carry out the latter, the bed plates upon which the converters are mounted are perforated, as shown at A in Fig. 6, the amount of air admitted to the converters being

regulated by simple slide valve or damper. The air is forced into the pit at one end at a pressure of $\frac{1}{4}$ ounce to the

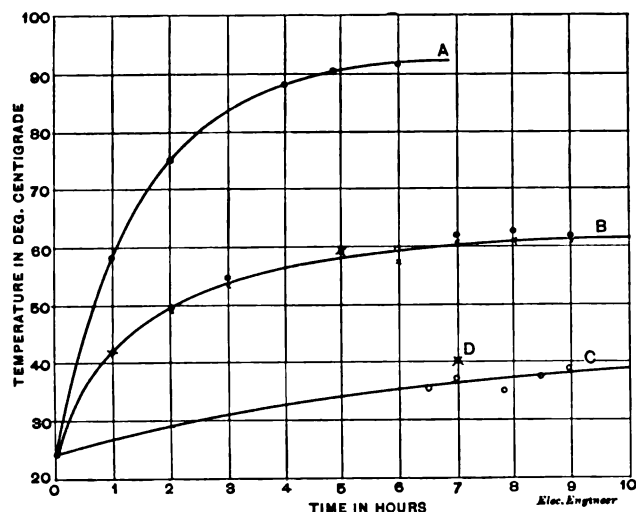


FIG. 5.

square inch. Mounted beside each pair of transformers is a switchboard, from which conductors lead to the alternating side of the rotary converters; while the current

delivered from the low tension side of the converters passes through a cable of 1,500,000 circular mills section, to the low tension switchboard.

Fig. 10 shows the distributing switchboard placed beside the static transformers, the upper section controlling the high tension, and the lower section the low tension, circuits. In order to economize space the indicating instruments of the boards will have their scales arranged in a vertical plane at right angles to the board, instead of parallel, as is the usual custom.

Current will be measurable through a shunt in the main conductor and indicated by an ammeter. The contacts of the field regulator for the rotary direct current converter are arranged in a column on a pedestal in order to save space on the switchboard, and are to be adjusted by means of a rack pinion. It is expected that the plant will be set up and ready for operation by Fall.

FAREWELL DINNER TO MR. GISBERT KAPP.

About 50 well-known electricians and professors met at dinner at the Whitehall Club, London, on July 23, to bid good-bye to Mr. Gisbert Kapp, and to present him with a souvenir marking the high estimation in which he stands in the eyes of the profession. The chair was taken by Mr. W. H. Preece, who made his usual felicitous speech in presenting Mr. Kapp with a silver salver, a non-magnetic watch, and an album of portraits of those present.

ELECTRIC TRANSPORTATION DEPARTMENT.

THE RENO UNDERGROUND RAPID TRANSIT SYSTEM.

The excellent records for efficiency and economy made during the past year upon the "Liverpool Elevated" and the "Intra-

the near future. The citizens of New York City in November will vote upon the question of the municipal construction of an underground system capable of furnishing real rapid transit.

The traffic returns for 1892 of the elevated and surface lines running North and South on Manhattan Island show that over

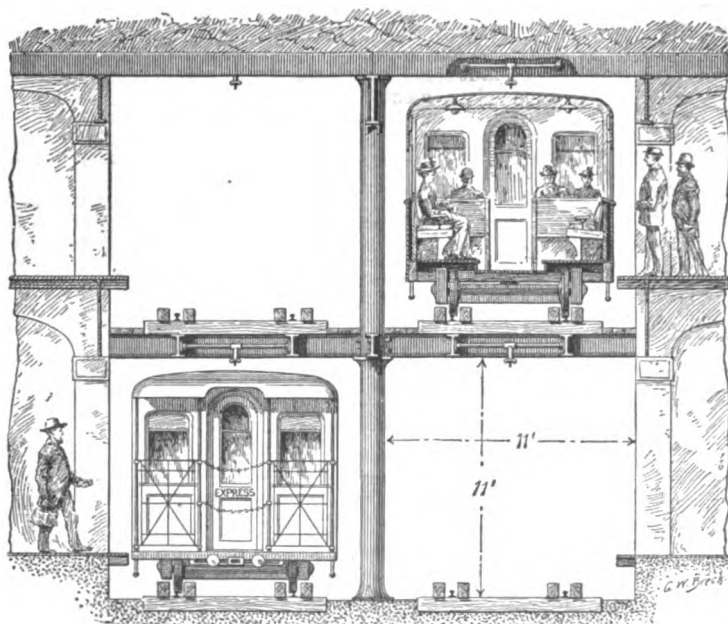


FIG. 1.—SECTION OF TUNNEL AT STATION.

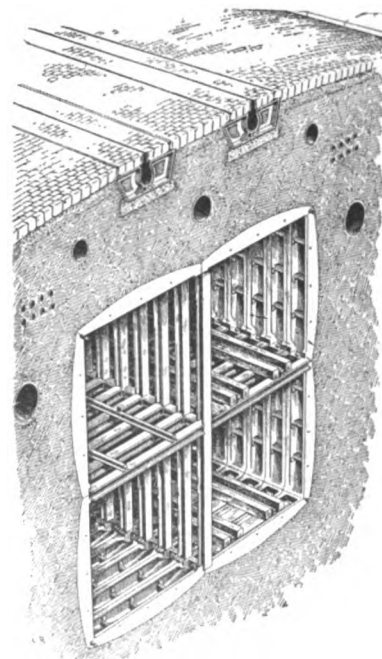


FIG. 2.—DETAILED CONSTRUCTION BELOW UNION SQUARE.

Mural" at the World's Fair and the "London and Southwark" Tunnel, are convincing proof that electricity is now abundantly able to handle the rapid transit traffic of any of the large cities. The managers of the Chicago Elevated Roads, having become convinced of this fact, as announced by us, have recently contracted for their electrical equipment and it also seems highly probable that the Manhattan system will follow their example in

440 million passengers were carried on these lines in that year, producing a revenue of \$22,000,000. This enormous traffic indicates that New York City is capable of furnishing the large number of passengers needed to guarantee the fixed charges upon a first-class four track underground system. The shape of Manhattan Island lends itself admirably for the application of electricity to such a railway system under Broadway and the

Boulevard, the "East Side" extension having still to be fixed upon.

Power Transmission.—Among the various plans proposed for the construction of an underground road in New York is that of Mr. Jesse W. Reno, of this city. In the Reno system, which we illustrate in the accompanying engravings, it is proposed to divide the required power between three central stations located at 8-mile intervals along the Hudson River from the Battery to Fort George ($10\frac{1}{4}$ miles). From each of these stations the electric current would be transmitted to the main line by underground conductors about $\frac{1}{4}$, $\frac{3}{4}$ and $1\frac{1}{4}$ miles in length, respectively.

The structure of this tunnel, as shown in the engravings,

train we have required for 31 stations and 100 trains a total of 10,600 lights which would consume 1,060 H. P.

Ventilation.—It is proposed to secure a positive system of ventilation by locating air shafts midway between each station, which would contain each a 6 ft. electric fan as shown in Fig. 8. These fans will exhaust the vitiated air from the tunnel and compel fresh air to enter the tunnel at the stations in order to replace it. The internal structure of this tunnel, as will be seen, admits of a single system of ventilation for all four tracks, which greatly simplifies this important problem. The ventilating shafts (not on the Boulevard) will consist of a lateral 6 ft. pipe containing a revolving fan leading from the side of the tunnel and connecting

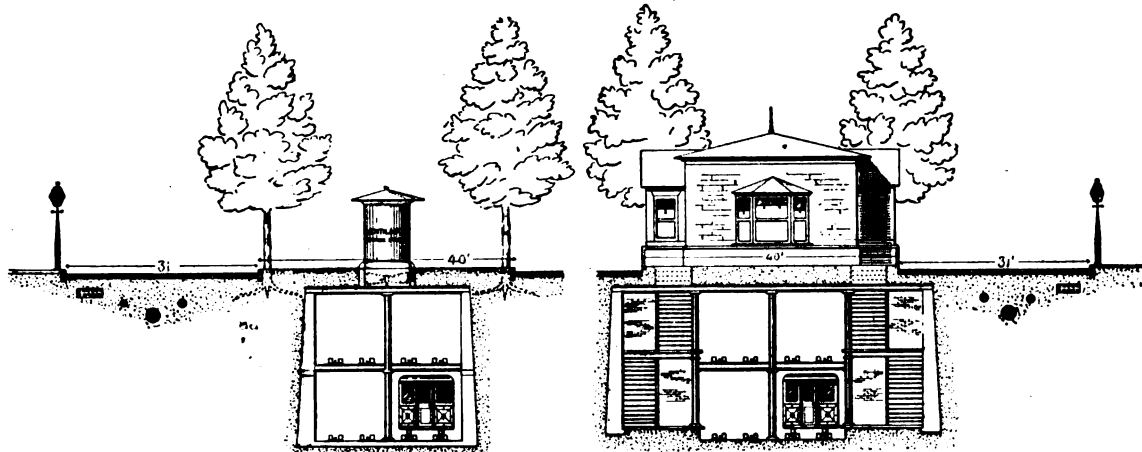


FIG. 3.—FIVE MILE SECTION AND TYPICAL BOULEVARD STATION, SHOWING TREES INTACT AND FOUR TRACKS SERVED BY ONE BUILDING.

Figs. 1 and 2, is particularly suited to the support of an electric conductor over each track. The overhead system has important advantages over the "third rail" system of transmission because it may be more perfectly insulated, presents the simplest construction at switches and crossings, and also because it is out of the way of the track workmen and avoids the possibility of a chance contact with the passengers. The current would be transmitted from this conductor to the train by a sliding contact device on the motor or motor car, as shown, while the return current would, of course, complete the circuit through the rails. With a substantial and thoroughly protected and insulated conductor, as this would be, there should be no difficulty in using a thousand-volt current which would admit of a very economical transmission.

If we go upon the assumption that 100 five-car trains will be sufficient to handle the traffic of the Broadway-Boulevard line

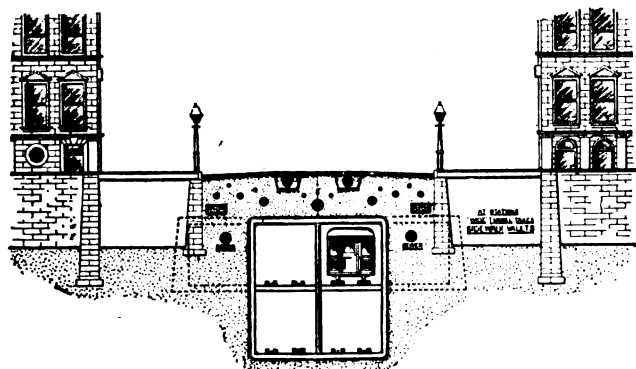


FIG. 4.—RENO TUNNEL SYSTEM COMPARED WITH WIDE TUNNEL UNDER BROADWAY.

and compare these trains with the four-car trains of the "Intramural"—which were able to develop, when required, a speed of 32 miles per hour, and showed an average consumption of motive power of 42 H. P. per train under the disadvantages of numerous curves and frequent stops,—it is safe to say that the average power required, per train, in the underground system would not exceed 75 H. P. This is the power that would be required at the generators, since all losses, including that of transmission, have been deducted. Consequently for 100 trains there would be required 7,500 H. P.

Lighting.—Allowing 100 lights per station and 75 lights per

with a suitable "up-cast" shaft adjacent to the building line in the side streets. Each of these ventilating shafts and fans would be capable of exhausting 32,000 cu. ft. of air per minute from the tunnel, which will ensure a very abundant ventilation with a small consumption of power. As 5 H. P. would be sufficient for each of the 40 fans required along the ten-mile section the total amount needed for this purpose would be only 200 H. P.

The above estimates on the actual power required for motive power, lighting and ventilation (9780 H. P.) show that if 5,000 H. P. be provided at each of the three stations there will be ample provision for all possible contingencies. The equipment of each station with two generators of 2,000 H. P. each and one of 1,000 H. P. would admit of very economical working, especially as the stations would be located on the Hudson River front, where cheap fuel and abundant condensing water could be obtained.

An independent electric locomotive could be attached to each train, but it would probably be advisable to use a motor car in place of the separate engine, at least for the way trains, where the frequent train accelerations, due to the numerous stations, would require great tractive effort.

It will be seen in Fig. 4, which compares the Reno plan with the wide tunnel under Broadway, that the roof of the tunnel, in order to clear the pipes and other sub-surface structures, is placed 8 ft. below the surface. This depth would locate the platforms of the way stations 18 ft. and of the express stations 30 ft. below the surface for stations below 59th street, and 18 and 25 ft., respectively, for the station platforms above 59th street.

In order to eliminate the objection, which might be made to the Reno tunnel, that passengers would dislike the increased depth of 12 ft. at which the ten express platforms are located, Mr. Reno has designed and put in operation an "inclined elevator" consisting of a continuously moving, inclined, rubber covered iron belt of special form, and provided with a moving hand rail. As the passengers are elevated as fast as they step upon the machine it follows that its capacity is enormous, so that it is particularly suited for effectively handling a stream of people as they are unloaded from a train. The elevator now in operation is capable of handling 6,000 passengers per hour at very small cost and as it is also operated by an electric motor it is admirably adapted for this proposed underground system.

STREET CARS AS TELEPHONE PAY STATIONS.

SUPT. CRILLEY of the Hartford Street Railway has proposed to put telephones in the street cars, operated on the trolley circuits, but independently of the regular telephone exchange. The messages would be sent into car headquarters and there transferred to the exchange service. The idea is that people coming into Hartford would use the service. We doubt the general feasibility of the scheme.

MISCELLANEOUS.

SOME FACTS ABOUT POLYPHASE MOTORS.¹

BY LOUIE BELL, PH. D.

In connection with the long distance transmission of power, most engineers will, I think, agree with me in the position that alternating current motors of some kind, and of alternating currents, preferably the polyphase variety, are almost a necessity. We have been forced to their use by the exigencies of long distance service, which compel either the total abandonment of continuous current or its use under very embarrassing conditions.

There has, however, been a tendency to look upon the polyphase motor as a somewhat undesirable resort to which we have been driven by long distance work. Such indeed was my own belief from a *priori* reasoning, and before I had obtained that practical knowledge of the subject which can only come from personal experience both with the design and application of any class of apparatus. By such experience, and by the commercial demands which have been coming in with steadily increasing frequency, I have been forced into taking the position that the polyphase motor is intrinsically preferable to the continuous current motor for a vast majority of all the uses to which such machinery may be applied.

At present, appearances indicate that not only will the polyphase motor displace direct current apparatus for most long distance transmission plants, but will prove a formidable competitor in all applications of motors to industrial purposes and this, although the polyphase apparatus is the growth of only a few years, while the direct current motor is the outcome of more than a decade of experience.

We may then, in instituting a comparison between polyphase and direct current motors, consider the various properties which a good motor of any kind must necessarily have. Mechanically speaking, we would all agree that it should be simple in construction, strong, not liable to frequent or considerable repairs, convenient in form and not excessive in weight. As regards its properties, it should in general run cool, stand over-loading without serious danger, run at a nearly constant speed, or be capable of considerable variation in speed if necessary. It should be capable for certain uses of sudden and violent exertion, and of easily changing its direction of rotation. In a purely electrical way, it should be simple, efficient both at high and low loads, and should not take excessive amounts of current either in starting or in running.

This represents a difficult list of conditions to fulfill with any one motor, but I believe they can be met better by polyphase than by direct current machines. A direct current motor, for instance, of a given construction and reasonable weight, cannot both run at a constant speed independent of load in a particular case and at the same time be capable of running at a wide variety of other speeds. It usually will not stand considerable over-loads without sparking, and at the same time give a fair efficiency at low loads; and so one might go on piling up difficulties. The polyphase motor, too, cannot meet all these conditions with equal success, but examining them one by one, you will find that on the whole we can obtain very excellent results.

Taking up seriatim the desirable properties which I have enumerated, and applying them to polyphase motors, we find as regards the first count that their construction is singularly free from complexity. They consist in general of two concentric masses of laminations forming respectively the field magnet and armature. The armature is assembled on its shaft much as in direct current machinery, while the field laminations are held together by a clamping spider of very simple construction. The bearings are supported either on end spiders fitted to the field spiders by lathe work only, or on pillow blocks of the ordinary kind. Commutator and commutator connections there are none, nor should there be collecting rings except in rare instances. The armature need be exposed only to low voltages, and should preferably be wound with a comparatively small number of rather massive conductors, united at the ends either by a single plate or by very simple connectors, the latter form being preferable. The field winding is usually in a greater number of coils than is a direct current field winding, but each coil has a comparatively small number of convolutions, making the total winding by no means complicated.

In lieu of the starting rheostat of the direct current motor, we have a starting resistance which should preferably be placed within the armature, and consists of a few zig zags of metal united at one end and connected at the other to three or more contact pieces. A solid collar short-circuiting these contacts and a forked lever to move the collar completes the equipment, as I am accustomed to employ it. Its most noticeable feature is that the revolving armature, the most troublesome and delicate part of a direct current machine, is free from complication, and that it is almost as solid

as if it were a solid mass of metal, and scarcely more liable to injury.

This very obvious simplicity of construction and mechanical strength is strong evidence of unusual freedom from repairs and as a result of experience I have found that the induction motor is singularly free from liability to accidents of every kind. I have never succeeded even by the severest kind of experimental work in burning out a field coil or doing any serious injury whatever to a motor, although I have kept some of them on static torque tests in rapid succession for hours at a time and have held them at rest and poured current through them until the leads burned off, the motor still remaining undamaged. If there is a test of extraordinary severity that I have not applied to induction motors, I have yet to learn of it. These properties are invaluable in commercial work inasmuch as they practically remove the danger of crippling the motor even under exceptionally unfavorable conditions.

As regards the convenience of the form of polyphase induction motors, I think an inspection of any of the types which have been brought out will render argument unnecessary.

The magnetic necessities of the case have led all makers of such apparatus in this country and elsewhere, to adopt a species of barrel shape as the general outline of the motor, modified only in the proportions of diameter to length and in the adoption of one form or another of bearing. The tendency of this construction is to bring the centre of gravity of the machine very low, thus insuring unusual stability and freedom from general vibration. This form, too, enables one to place the motor in almost any position which is convenient in applying it upside down, as a side bracket, and the like.

The largest installation of induction motors in the world just put in operation in Columbia, S. C., aggregating over 1,200 H. P., is composed of inverted motors with their bases bolted to the ceiling timbers of the rooms.

As regards weight, the abolition of any sparking limit to the output, and the excellent magnetic materials used, might naturally be supposed to lead to motors of unusually light weight, and such is in fact the case. Sixty to seventy pounds per horse power in motors of moderate size is a figure easily reached without any sacrifice of efficiency, and if occasion requires these limits can be passed with great facility, 25 to 30 pounds of material per horse power being quite attainable in large units while still retaining satisfactory general properties. I must say, however, that for most uses I do not consider extreme lightness either necessary or desirable, although it is important to be able to secure it if necessary. So much for the mechanical character of induction motors.

Electrically speaking, the case is just as favorable. Unless forced to a very large output per pound of weight, an induction motor will run quite cool, at a heating limit in fact below that of most direct current machines of similar weight and output. This advantage is mainly due to the very substantial character of winding which can be conveniently employed and to the fact that the winding is distributed so that the losses in the copper are not localized while the laminated character of the structure facilitates through ventilation. This freedom from excessive heating indicates that the polyphase motor can stand considerable overloading without any serious results and experience has shown this to be the case. The worst that can really happen is that the motor may fall out of synchronism when the load is sufficiently great, thereby blowing the fuses in the primary line.

As sparking is obviated in this type of machine it can readily be rated at such output as will give a proper limit of heating, and this output will in most cases allow from 80 to 60 per cent. of overloading before the machine will drop out of step. A wider range than this can be obtained if desirable, which it is generally not.

The limit of possible overloading, fixes in a general way the possible static torque that can be obtained from a given machine and this is apparently purely a matter of convenience in design, anything that can reasonably be required being quite attainable. There is no special difficulty in arranging polyphase motors for a starting torque four or five times the running torque, although this would be unnecessary except for severe hoisting and tramway work. At running torque the starting current taken may readily be no greater than the running current. From this it will readily be seen that a properly planned polyphase motor is easily capable of very great and violent exertions in a case of necessity. It will even endure complete reversal under full load within 10 or 15 seconds on motors of ordinary sizes, this time being sufficient for the machine to pass from full load in one direction to full load and speed in the other direction. This reversal is, as is well known, accomplished simply by reversing any two of the primary wires, the effect being to rotate the field in the opposite direction from the armature thus causing an enormous rate of cutting lines of force and consequently immense effort causing the motor to stop and reverse.

SPEED VARIATION IN POLYPHASE MOTORS.

This subject has been for the most part in a rather hazy condition up to the present time. The induction motor has been generally known as non-synchronous, and such indeed it is. The name, however, has been frequently used in ignorance of

1. A paper presented at the 11th General Meeting of the American Institute of Electrical Engineers, Philadelphia, May 18, 1894.

the fact that an induction motor always tends towards synchronous running.

Under ordinary conditions the polyphase induction motor can be made to run at nearly constant speed independent of load, resembling in this respect a well designed shunt motor. A variation from no load to full load of 5 to 6 per cent. in speed would represent ordinary good practice, either in a shunt motor or a polyphase one, this limit being exceeded only in small motors or types which may be regarded as special. It is by no means difficult however so to design a polyphase motor that the speed shall possess very remarkable uniformity. This condition has been valuable in the Columbia plant previously alluded to. In this case tests of 17 motors showed a maximum variation in speed, from an output of 75 H. P. to friction load of the motor, of only 2.2 per cent., individual motors showing slighter variations down to 1½ per cent.

The task of these particular motors is driving a cotton mill, hence the necessity for uniform speed. And this uniformity in speed is not greatly affected by variations in voltage, which would be quite sufficient to cause considerable speed variation in a shunt wound motor; in fact, the induction motor is remarkably insensitive to moderate variations in voltage, unless it is heavily loaded.

This uniformity in speed has frequently been urged as an objection to the induction motor, barring its employment in cases where speed variation is necessary. This point is not well taken.

The induction motor can not be made successfully to run at reduced speed by varying the primary voltage. Under these circumstances the output of the machine falls off somewhat more rapidly than the square of the voltage, so that only trifling speed variations are possible. It is a fact, not generally known, however, that the speed of a polyphase motor can be varied with the same facility and within the same wide range as is possible in the case of a series wound continuous current machine, such as a railway motor. This is accomplished in the induction motor by a rheostat in the secondary circuit, just as it is accomplished in the series motor by a rheostat in the main circuit. Thus equipped, the two machines behave almost exactly alike. The speed at constant torque can be made to vary from full speed down to almost no speed, thus simulating the action of the series motor in the closest possible fashion. At any given speed an increase or decrease of the torque will decrease or increase the speed substantially alike in both classes of motors. In both, too, the efficiency is initially similar and falls off in practically the same ratio. A non-inductive resistance is necessary in case of the polyphase motor, an inductive one throwing the armature current so far out of phase as to interfere with the proper action of the motor.

Fig. 1 gives an excellent idea of the behavior of a polyphase motor with resistance in the secondary circuit.

Curve A shows the speed and output of a certain motor under these circumstances. It was a four-pole machine operated at 50 cycles per second and the initial speed was reduced to 1,400 by the resistance of the leads reaching across the room to the rheostat composed of loops of manganin strips which would be systematically varied. It will be seen that the word curve is almost a misnomer, the ratio between the speed and output at constant

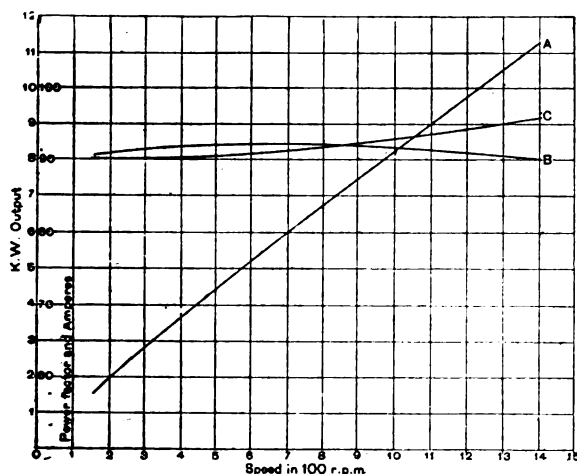


FIG. 1.

torque being almost a linear function, even when the speed fell to as low as 150 revolutions per minute. It was not carried lower than this only because of lack of adaptability in the rheostat. No series motor could show a more satisfactory result.

Curve B shows the power factor under these varying conditions. It is high at all loads and speeds, varying slightly with a maximum at about half speed.

Curve C shows the variation in current. This, as can be seen,

is almost constant, falling off slightly at the lower speeds, the voltage being uniform throughout the test.

Speed variation by this method is not as efficient as might be wished but still compares favorably with that obtained in a series motor with rheostatic control. Some modified methods of control promising a somewhat better efficiency have been suggested, but it seems probable that in the net result we shall find that continuous current and polyphase motors are about on a par in this

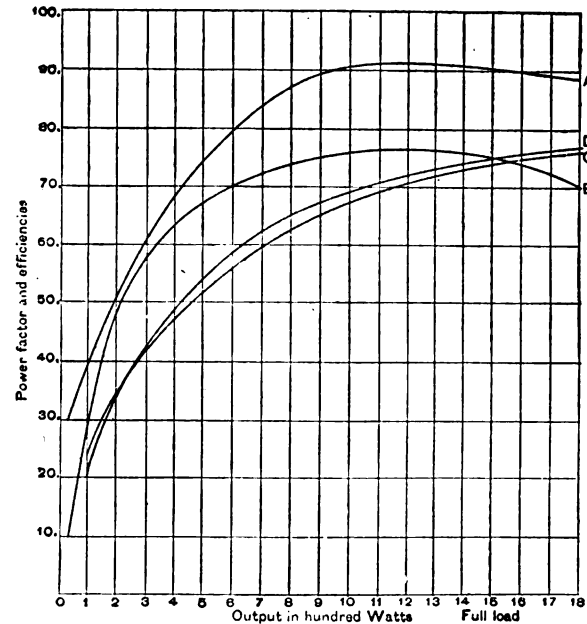


FIG. 2.

respect. It should be noted that in continuous current motors, speed variation by weakening the field is only practicable within a very limited range and requires an abnormally heavy motor. I think that with a similar change in design the polyphase motor could be made to operate nearly as well by change in its field strength. An efficient speed variation through a very wide range is attainable in either class of machine only by extraordinary means, as an elaborate combination of direct current machines, or frequently changing devices in the polyphase machines. From what has been said it will be apparent that the polyphase motor is perfectly capable of a complete control of speed on the same terms generally obtained with continuous current motors.

COMPARISON OF A POLYPHASE AND CONTINUOUS MOTOR.

Fig. 2 gives a striking comparison between the properties of the two classes of machines under consideration. The polyphase motor selected for comparison is of 2 H. P. output representing the average small motor to be found in central station practice. This particular size weighs 218 lbs. complete, and runs at a speed of about 1,400 revolutions per minute on 50 cycles, loaded. It is relatively neither better nor worse than polyphase motors of other sizes, as may be seen by reference to the curves in my previous paper on this general topic. The power factor in this case rises quite sharply, reaching 86 per cent. at half load and through most of the working range of the motor remains at or near 90 per cent., nearly 91 per cent. as a maximum. The efficiency has its maximum a little under full load of the motor and reaches nearly 77 per cent., being 75 per cent. at full load. Both power factor and efficiency hold high values from half load up and do not fall off seriously until some distance below half load.

Contrast with curves A and B belonging to the polyphase motor, curves C and D; the former is the efficiency curve of a 2 H. P. 500 volt motor of one of the well-known American makes, and curve D is a similar curve for a 2 H. P. 110 volt motor of European manufacture. These are not selected curves but were the two completest available. Both these curves, C and D, show remarkable similarity. Neither of the motors sparked seriously at full load, the load limit being set rather by the heating. Both curves rise slowly and attain their maximum values at some point beyond the available load of the machine. At full load the efficiency is substantially the same as that of the triphase motor. At low loads it is noticeably worse. I think C and D are fair average machines. In tests of a wide variety of motors, some higher and lower efficiencies would be found. Such, too, would be the case in testing a variety of polyphase motors. In fact the mate of the triphase motor shown, sent through the factory at the same time, showed about 1½ per cent. higher efficiency but a complete test was not attainable as the machine had to be immediately shipped. A

comparison of these curves will render it evident, that it is quite practicable to produce a polyphase motor having an efficiency fully equal to that of direct current motors of similar size and I think the tendency will be towards better efficiency at moderate loads. It should be mentioned here that the two horse-power triphase motor was made of ordinary good armature iron, not selected, or specially treated in any way.

Finally let me call sharp attention to curve Fig. 8 which shows the effect of the power factor, which I regret to say has been talked about not wisely but too well in most of the discussions pertaining to polyphase apparatus. Two curves in Fig. 8, show the total current in the line in the 2 H. P. triphase motor and the 110 volt continuous current motor above mentioned. The current curve of the continuous current machine is nearly a straight line, that of the polyphase machine is almost tangent to it and slightly concave upwards. A noticeable fact displayed is that throughout the ordinary working range of these two motors the currents were substantially equal, the existence of the power factor in the polyphase motor being only noticeable at very low loads and at overloads. This comparison should be a sufficient answer to the charges of excessive current that have so often been made against the polyphase machines. In a bad polyphase motor they would have foundation in fact. In a rather good one the net effect of the lagging current is trifling. It should further be noted that the current in this triphase motor at friction load is only about 80 per cent. of the current at full load and of this only 80 per cent. represents loss of energy. This is in marked contrast with the results obtained from a foreign triphase motor of similar size exhibited at the World's Fair, in which the no load current was nearly equal to that at full load and the power factor at full load was barely over 50 per cent.

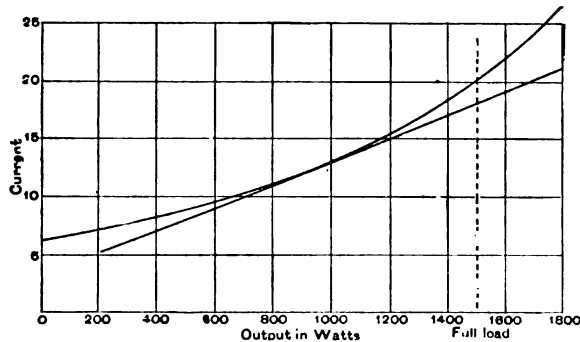


FIG. 8.

In this brief discussion of some of the properties of modern polyphase motors, I have endeavored to show how nearly they fulfill the conditions which may be regarded as desirable in electric motors in general. That they do so as well, if not better, than the continuous current machines of similar capacity I believe that I have satisfactorily shown.

The demand which certainly is arising for polyphase motors for general power purposes based on their intrinsic merits, indicates that the older type of machinery has found a dangerous rival, all questions of long distance transmission aside.

ELECTRICITY AS A FIRE HAZARD.—VII.

BY W. J. JENKS.

IN WHAT DO THE FIRE HAZARDS OF ELECTRIC LIGHT AND POWER SYSTEMS CONSIST?

I TRUST it will be noted that in answering this question, as well as in discussing other divisions of this broad subject, I speak from the standpoint of American engineers, that is, I refer especially to those difficulties which have been developed in constructing systems in accordance with methods which have found favor in the United States.

While, therefore, the general possibilities of difficulty apply to systems of similar character everywhere, the points to which special attention is now directed are among those which form the living issues in this country. To these I trust that in the discussion which this subject arouses, may be added any others which have commanded attention elsewhere, possibly in advance of their recognition here, perhaps because of the existence of different conditions or modes of operation from those which confront the American constructor. The possible hazards are few and easily remembered:

1. Poor regulation of dynamos.
2. Poor arrangement of translators.
3. Poor conductors.
4. Poor insulation

These may be profitably considered more in detail:

1. Poor regulation of the dynamo is a departure from the pressure or difference of potential required under varying conditions by the translating devices. The securing of proper pressure is good regulation, because under normal conditions this pressure is expended, at the rate (per unit of resistance or counter electromotive force) for which lamps or motors are designed. Where such translating devices are connected in series, good regulation consists in so varying the pressure as to maintain the current constant; where they are arranged in multiple arc, good regulation demands that the pressure shall be constant and so long as this constant delivery is maintained at the terminals of the devices to be supplied, no further attention is necessary at the source of energy.

In each case abnormal increase of potential results in abnormal current and this may set on fire the coils of arc lamps, explode incandescent lamps, and unduly heat the conductors of all parts of the circuit. The construction of automatic regulators to maintain constant current in series circuits and constant potential in multiple arc circuits, has within recent years minimized this difficulty.

2. An improper arrangement or placing of arc lamps, incandescent lamps or motors. This may result in the ignition of surrounding combustible material, by sparks and the falling of hot carbon from arc lamps during their period of service, or by the direct action of the confined heat of incandescent lamps, or by the over-loading of motors, resulting in the reduction of the counter-pressure which they develop, and consequently in an increase of the current flowing through their mechanism up to the point of heating their coils and armatures. These are now uncommon sources of danger.

With the improved automatic cut-outs of the best arc lamps, by which the current is switched around instead of being allowed to pass through them, whenever it rises in a dangerous degree above the normal standard, or whenever the arc becomes so long as to place surrounding substances in danger, with spark arresters above the wire nettings around their globes when placed over inflammable material, there is little trouble. It is popularly supposed that an incandescent lamp cannot possibly radiate heat enough to set on fire surrounding substances, and show windows often display delicate lace fabrics in close contact with such lamps. This is simply taking unwarrantable chances, for it is merely a question of confinement and accumulation of the small heat, and the degree of readiness with which any given material will ignite. Colored and smoked lamps become much hotter than clear ones, and when the vacuum has become impaired, the conduction from the hot carbon filament across the intervening space to the bulb, is so rapid that the filament can hardly be forced up to its proper candle-power and the globe may become a source of danger, if in contact even with wood work. Safety to motors is secured by proper fuses.

3. By poor conductors, I mean such as are from any cause insufficient to maintain practical continuity at all parts of the circuit, and by "practical continuity," I mean to be understood, such a condition of the conducting material as to allow of the transmission of electric energy without danger. The necessity of such perfect continuity between the dynamo and the translating devices was recognized very early in practical electric light and power construction.

There are three conditions under which difficulties of this sort are liable to arise, and all of them are of especial interest to insurance men:

(a). By commutators of motors or switches forming part of resistance devices or regulators. There have lately come to light several cases showing a trouble which will doubtless soon be satisfactorily corrected, in the sparking which sometimes occurs when the circuit of an elevator motor is broken by the switch operated by the attendant at a distance. Under all circumstances where similar conditions are found, there is need of special protection, and this is occasionally true of other forms of switches by which such circuits are voluntarily closed or broken.

(b). By safety fuses, which may be called the automatic switches by means of which, without deliberate action on the part of anybody, the circuit is opened either as the result of the gradual melting of the fusible conductor in the case of an over-load, or by the instantaneous and disruptive action which occurs at the same point in case of a short-circuit. When these devices were first practically used with pressures of 100 volts or thereabouts, no difficulty was anticipated excepting that the falling of molten globules of the fusible material might set fire to inflammable substances. It is not considered necessary to support such fuses upon bases impervious to moisture or incombustible, but it has proved that such bases were essential, particularly with pressures like those of ordinary electric railway systems, where the melting of the fuse sometimes produced an arc between the terminals which remained, and that this arc would, unless these terminals were separated from each other by sufficient distance, destroy the terminals and set fire to surrounding or supporting material. It is only within very recent times that engineers have appreciated the explosive action which

accompanies a short circuit, and the necessity of placing the fuses which constitute the weak links in the chain of conduction, so that in case these links break by reason of any abnormal current, the result of their rupture in an almost infinitely minute interval of time may not injure their surroundings.

(c). Arcs occasioned by poor joints, accidental breaks or overheating. It sometimes happens that a conductor may become, for the practical purpose of carrying the current which it is expected to transmit, entirely severed, although in such instances its ends may not be pulled apart to a sufficient distance to prevent the flow from taking place. Such an accident may arise from an obscure fault in the wire itself, injury from the tools of mechanics who may interfere with the conductors after they are placed, and other causes. Sometimes a brittle wire will break inside the insulating covering, or its carrying capacity will be so much reduced by cracking that heat will be occasioned at that point the moment any considerable current is applied. In other cases, joints having imperfect contact with binding screws, or a small surface of contact with such screws or between ends spliced together, may occasion so high a resistance that heat may be developed and the metal become melted. Any one of these causes may be sufficient to produce an arc in series with lamps or

In a constant potential circuit the heating of an imperfect joint may, if it can affect a conductor of opposite polarity, as for instance, when positive and negative wires are close together, call a large amount of energy to a single point, as in the cases we have already considered in connection with fixtures. With a pressure of several hundred volts, as in electric railway construction, the arc may prove a serious matter even if a short circuit is not produced. Happily instances of this variety are not common.

The over-heating of conductors from currents too great for them to transmit when so incased as to prevent easy radiation, or from any other cause, was one of the earliest difficulties recognized by both insurance men and electrical engineers, as is clearly evidenced by the foregoing extracts from expressions of solicitude on the part of the underwriters. This is avoided by proportioning the size of the wire to the amperes it must conduct and this method is effective in both series and multiple arc circuits, the former being adapted in the mass or gross section of the wires for the amperes which are to be constantly expected, the latter for the maximum expected.

It is interesting to note that the tables of "safe carrying capacity" which have now for several years been made a part of the best rules for constructors, have lately been objected to on the ground that there is in them a larger margin of safety than is necessary in practice. To quote the expression of a recent statement of the case by one of the best engineers now in the electric light and power field:

"The table showing safe carrying capacity of conductors is, I think, entirely too rigid. Fully sixty per cent. more current can be safely carried than shown in table, and at least forty per cent. more could be allowed with just as much safety as the amounts indicated in the table. This table necessitates the use of very large wires where the distance is short and the number of lights considerable.

On the same point, another intelligent engineer says:

"I think the capacities of wires given in the present rules of the underwriters are too low; they correspond to a rise of temperature less than 80° F. They could be increased 50 per cent. without the possibility of danger. These narrow limits of admissible current often seriously increase the expense of obtaining a uniform distribution of potential."

Some time ago I thought it wise, in view of the great importance of this matter of safe carrying capacity to the question of security from fire hazards, to request of Prof. A. E. Kennelly, electrician at the Edison laboratory, an opinion as to whether the margin of safety established by The National Code of insurance rules was from a theoretical standpoint unnecessarily large. Mr. Kennelly's judgment in matters of this kind is entitled to great weight in view of his numerous exhaustive experiments in many directions, and particularly because of his work in 1889 summarized in his paper on "Heating Conductors by Electric Currents" read at the Niagara Falls meeting of the Association of Edison Illuminating Companies, August 18th of that year. This paper was at the time circulated in pamphlet form, widely reproduced by the electrical journals and has become a classic in this field. Professor Kennelly replied, under date of January 11th, 1893, as follows:

"The table of safe currents given on page 7 of the National Code is in practical agreement with the table of safe currents appearing on page 10 of my report upon the heating of conductors. The definition in the Code of what constitutes the safe carrying capacity of a wire, I must, however, disclaim. In fact, I never ventured to express an opinion as to what was, or should be stated as, the safe carrying capacity of a conductor. The duty I endeavored to accomplish was to ascertain experimentally what temperature elevation could be produced in a given size of conductor by a specified current strength uniformly maintained through it. Having given the results, I looked for existing definitions of safe carrying capacity, and found that recommended by the committee of the Institution of Electrical Engineers (London) 'On fire risks in electric lighting,' as mentioned on page 8 of my report and the table on page 10 merely translates that recommended rule into actual wires and currents.

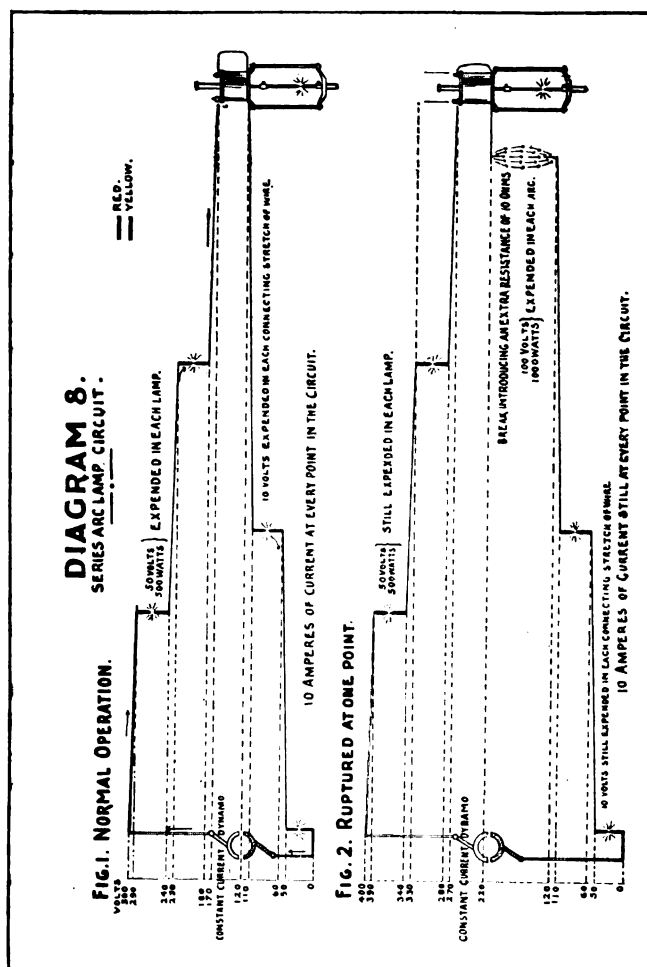
"The rule means that the temperature elevation of the wire under load is practically 10 degrees C. or 18 degrees F. above surrounding bodies. Just what reasons the committee had for recommending that rule we cannot say, but it certainly seems very safe—unnecessarily safe probably, and I have always believed that this measure would in time be amended. The data supplied by the report submitted to you enable a scale of sizes to be established for any temperature elevation that may be fixed upon.

"I have just found that the physiological definition of safe carrying capacity on page 7 in The National Code, means in my own case a temperature attained of just about 50 degrees C.

"Taking the normal temperature of wires as 24 degrees C. on the average, this would mean a full load elevation of 26 degrees C., say 25 degrees, or $2\frac{1}{2}$ times as much elevation as the National Code table allows, representing an increase in all the currents of roughly 55 per cent. In my opinion that would be still a safe temperature.

Yours very faithfully,

Yours very faithfully,
A. E. KENNELLY."



motors, and such a danger has been found to be of the most serious character because it does not increase, but ordinarily decreases, the flow of current through the circuit and consequently does not operate to melt any safety fuses and thus automatically remedy itself. In case of an occurrence of this sort in a series circuit, the resistance of the arc is added to the resistance of the conductor and lamps, and the dynamo strives by reason of its construction to maintain a constant current, even though that current be relatively small. Such a case is illustrated in "Diagram 8—Series Arc Lamp Circuit." Here an abnormal resistance is shown to increase the potential generated by the dynamo and cause an expenditure of the electrical energy at the point of break which may be sufficient to start a fire, more particularly because, as illustrated in Fig. 2 of this diagram, 1,000 watts or nearly $1\frac{1}{2}$ horse power is expended in the form of an arc, nearly double the energy required for a 2,000-candle power arc lamp, and producing the most intense heat which man has thus far been able to secure.

THE ELECTRICAL ENGINEER.

[INCORPORATED]

PUBLISHED EVERY WEDNESDAY AT

303 Broadway, New York.

Telephone: 3860 Cortlandt.

Cable Address: LENGINEER.

Geo. M. Phelps, President.

F. R. COLVIN, Treas. and Business Manager.

Edited by

T. COMMERFORD MARTIN AND JOSEPH WETZLER.

Associate Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue, Boston, Mass.

Western Editor and Manager O. KAMMEYER, 1430 Monadnock Building, Chicago, Ill.

New York Representative, 303 Broadway, } W. F. HANES.
Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada, - - - - -	per annum, \$3.00
Four or more Copies, in Clubs (each) - - - - -	2.50
Great Britain and other Foreign Countries within the Postal Union " - - - - -	5.00
Single Copies, - - - - -	.10

[Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1893.]

EDITORIAL ANNOUNCEMENTS.

Addresses.—Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of THE ELECTRICAL ENGINEER. Communications for the attention of the editors should be addressed, EDITOR OF THE ELECTRICAL ENGINEER, 303 Broadway, New York City.

Communications suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.

Advertisements.—We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers.

VOL. XVIII. NEW YORK, AUGUST 15, 1894. No. 828.

CONTENTS.

EDITORIAL :—	PAGE.
Electrical Work at Niagara.....	180
The Cost of Producing Electrical Energy.....	190
Electricity and Sanitation.....	181
Edison Lamp Litigation.....	181
Leaderettes.....	181
ARTICLES :—	
The Pittsburgh Reduction Co.'s Electric Plant at Niagara Falls (illustr.).....	121
TRANSPORTATION DEPARTMENT :—	
The Reno Underground Rapid Transit System (illustr.).....	124
Street Cars as Telephone Pay Stations.....	125
MISCELLANEOUS :—	
Some Facts About Polyphase Motors (illustr.).....	Dr. LOUIS BELL. 193
Electricity as a Fire Hazard.—VII. (illustr.).....	W. J. JENKS. 193
Cost of Producing Electrical Energy (illustr.).....	B. J. ARNOLD. 193
LEGAL NOTES :—	
Incandescent Lamp Litigation.....	185
PERSONAL :—	
Mr. H. L. Webb.....	185
OBITUARY :—	
O. H. Rudd.....	185
INVENTORS' RECORD :—	
Classified Digest of Electrical Patents Issued Aug. 7, 1894.....	136
NEWS AND NOTES :—	
Farewell Dinner to Mr. Gisbert Kapp.....	124
16th Annual Clambake of the American Electrical Works.....	131
The Buffalo-Niagara Line.....	131
"Let Your Light so Shine," etc.....	124
Sports of Brooklyn Boys.....	124
Paper Telegraph Poles.....	124
LETTERS TO EDITOR :—	
Street Lighting by Alternating Arcs.....	BUFFALO BILL. 136
TRADE NOTES AND NOVELTIES AND MECHANICAL DEPARTMENT :—	
New "Steel" Railway Motor (illustr.)—New Siemens & Halske Plant.....	
Chloride Accumulator Storage Battery Station for New York.....	
J. H. Bunnell & Co.'s Railway Catalogue (illustr.)—Assignment of Queen & Co.—National Conduit Manufacturing Co.....	137
The Falkenau Engineering Co., Ltd. (illustr.).....	138
Recent Sales of Acme Filters.—The Ohio Trolley (illustr.)—Test of Lundell Fan Motors.....	139
New Central Station for Bradford, Pa.—Telescopic Iron Armored Insulating Conduit for Underground Work (illustr.)—New York Notes.—New England Notes.—Western Notes.....	140

ELECTRICAL WORK AT NIAGARA.

THE construction of the electrical apparatus required for the power transmission at Niagara Falls is rapidly nearing completion and at the present rate of progress the early Fall will see the first dynamo in its place and at its work. In this week's issue we describe one of the first large applications of Niagara power—the plant of the Pittsburgh Reduction Company for the reduction of aluminum. This apparatus is interesting on more than one account, presenting, as it does, the largest outfit for converting alternating current into continuous current thus far installed. In considering the methods adopted for this purpose it might, at first sight, appear to some that complication had been introduced, and that the rotary transformer, at least, might have been replaced by a revolving commutator. Indeed, this plan was one among those proposed. Stress was laid on the successful operation of such a plan in some installations abroad, but we think that the advocates of the revolving commutator method can hardly have given full weight to the conditions, as they present themselves at Niagara. While there is no doubt that commutation by revolving commutators can be carried out successfully, the amount of current which can be so converted is small; a few hundred amperes probably being the limit to which such a device can be employed without incurring danger of self destruction. It is evident that the brushes must be very accurately adjusted in order to avoid destructive sparking, and when it is considered that variations in load may at any time cause a shifting of the current wave, the adoption of revolving commutators would require not only a large number of them to handle the heavy current to be employed, but would make the cost of attendance a formidable item of expense. With the rotary transformer all these difficulties are obviated, and hence its selection by the Cataract Company.

Another noteworthy feature of this plan is the adoption of an air blast for cooling the converter. It is evident that as the surface of a converter increases approximately as the square while the weight increases as the cube of the linear dimension, the radiating surface of large converters is smaller, comparatively, than that of small converters, and therefore special provision has been made for the cooling of the 200-kilowatt transformers to be employed. The results of the tests, as given in another column, would seem to show that artificial cooling may lead to a still greater increase of output per pound of material in converters than that attained hitherto.

THE COST OF PRODUCING ELECTRICAL ENERGY.

MUCH attention has lately been bestowed on the study of the causes which affect the cost of producing electrical energy in central stations, and, indeed, there is scarcely a meeting of an electrical character in which the subject is not discussed in greater or less detail. The recent paper by Mr. Crompton gave us an excellent insight into the results obtained in England and Mr. B. J. Arnold, in his paper read before the Northwestern Electrical Association, printed elsewhere in this issue, has done well to incorporate Mr. Crompton's results in his own and to add the figures obtained in a number of continental European stations. Mr. Arnold's own tests prove again the economy

of making the load of the station uniform and bring out strongly the value of the storage battery in attaining this object. The German central stations have, we think, sufficiently demonstrated the value of this auxiliary, and we are glad to believe that signs are not lacking which indicate a gradual awakening to its importance, in America. The New York and Boston Edison companies have already installed storage battery plants and we note in another column the step about to be taken by the New York Edison Company in the equipment of a new battery substation with a capacity of no less than 8,000 kilowatt hours employing Chloride accumulators for the purpose. This battery station will be situated midway between the Elm and 26th Street stations of the company and will be so arranged that it can be charged from either one or both of the two stations mentioned, thus affording every means for economical operation of the existing plants. The paper to be read by Mr. R. R. Bowker, of New York, before the Association of Edison Illuminating Companies at Boston, this week, will without doubt shed some valuable light on the storage battery as applied to American central stations.

ELECTRICITY AND SANITATION.

Our daily contemporaries are justly laying much stress on the excellent showing of the public health of New York during the recent prolonged hot period. Various causes have been assigned to account for this encouraging state of affairs, including the better condition of the streets, better sanitation in houses and general cleanliness; but thus far it has not been pointed out by any of our contemporaries that these good results may be ascribed to the excellent condition of New York's water supply. That the city's water has been maintained in good condition may, we think, be fairly ascribed, in large part, to the continued operation of the Woolf electrozone plant, installed last year at Brewster's, on one of the sources of the water supply. This assumption seems justified by the marked diminution in deaths due to enteric diseases, which are largely caused by contaminated water. With these results before us it ought not to be difficult to convince the authorities in many of our large cities suffering from bad water supply, that a vast improvement can be effected at a practically nominal cost by the aid of electricity.

EDISON LAMP LITIGATION.

THE case of the Star Electric Company [formerly Sunbeam Co.] differs somewhat from other adjudicated cases. We print elsewhere the opinion of Judge Seaman enjoining the defendants.

It will be observed that the Star company made a defense substantially the same as that set up successfully by the Buckeye company last year, before Judge Ricks, namely, that the complainants were estopped by the amendment which they had caused to be added to the patent in 1883, limiting its period by the term of the English patent of November 10, 1879, (to November 10, 1893). Although Judge Ricks had found such estoppel efficacious in the circumstances of the Buckeye company, Judge Seaman found that the Star company was estopped from pleading it by reason of the

agreement, with the complainants, of its predecessor, the Sunbeam Incandescent Lamp Co.—consisting of the same persons in interest,—of May, 1893. That agreement, entered into in a settlement of the infringement suit against the Sunbeam company, admitted the validity of the Edison patent and was subsequent to the cancellation of the amendment of the patent limiting its term by that of the English patent. That is to say, it accepted the patent in its form at that time. It is, as Judge Seaman points out, a case where an estoppel stops off an estoppel.

Meeting of the A. A. A. S.

OUR readers in this vicinity will hardly need a reminder of the annual meeting of the American Association for the Advancement of Science to be held in Brooklyn. The meeting will begin Thursday, August 16, and continue about ten days. Sections B, Physics, and C, Chemistry, cover topics that often bring out, in the way of papers and discussion, points of interest to electricians.

The general meetings will be held in the Academy of Music. The section meetings will be provided for in the Polytechnic Institute and the Packer Institute adjacent.

The Edison Convention at Boston.

As we go to press the members of the Association of Edison Illuminating Companies are gathering for their annual meeting, in Boston. The list of papers to be read indicates that the high standard of former years will be fully maintained, if not exceeded. We can only express the hope that the Association will permit of their publication.

16th ANNUAL CLAMBAKE OF THE AMERICAN ELECTRICAL WORKS.

Mr. J. E. Cates, of No. 10 Cortlandt St., New York, has issued the following notice to the electrical fraternity:

A commodious ocean steamer has been chartered to run to Providence on the occasion of the Sixteenth Annual Clam Bake of the American Electrical Works, to be held August 25th.

A number of gentlemen who are to attend thought it would make a pleasant outing to take a steamer, leave New York, Friday, August 24th, reach Providence Saturday morning early, attend the Clam Bake, leave Providence early Sunday morning and run to Newport, remaining until 7 or 8 P. M. Sunday, and arriving at New York about 7 A. M. Monday.

The idea being presented to me, I have chartered the steamer and will make the trip, providing there are a sufficient number who will signify their intention to take this trip by August 15th. If by this time there are enough, subscribers will be notified and tickets must be purchased by August 20th. The price of tickets will be \$20.00, including stateroom for the trip. Meals will be extra, and will be furnished at reasonable rates. Itinerary and full particulars later. Kindly advise me at your earliest possible convenience of your intention of joining this party.

THE BUFFALO-NIAGARA LINE.

MR. FRANK W. HAWLEY, Vice-President of the Cataract General Electric Company, which has the contract for stringing wires along the Erie Canal from Buffalo to Albany in order to furnish electric motive power for canal boats, is quoted as saying that about 20,000 horse power would be brought into Buffalo from the Niagara Falls Electric plant early in October next. The opening of the Buffalo-Niagara line will be made the occasion for a great public demonstration at Niagara and Buffalo. After that the construction of the lines east from Buffalo will be commenced. The company expects to reach Rochester with its power line, which will parallel the Falls Branch of the New York Central Railroad, by April 15 next. From Rochester the line will parallel the Auburn Branch of the New York Central Road to Canandaigua, Geneva, Seneca Falls, and Auburn to Syracuse.

COST OF PRODUCING ELECTRICAL ENERGY.¹

BY B. J. ARNOLD.

It was my intention when asked to prepare a paper upon this subject, to be read before this convention, to point out some of the principal sources of loss in the operation of the present central station, and afterward to assume an ideal plant, designed in accordance with the latest practice, and show at what price per kilowatt hour the average station could deliver electrical energy to the consumer.

After the paper was partially prepared on this basis, Mr. R. E. Crompton read before the Institution of Electrical Engineers of London a paper covering practically this ground, in which he shows that with coal having a calorific value of 14,500 B. T. units, and with boilers capable of evaporating 12 pounds of water at a pressure of 150 pounds, and the losses so proportioned that $2\frac{1}{2}$ pounds of this coal will evaporate 25 pounds of water, that a kilowatt hour can be produced for 8 cents and delivered to the customer for 6 cents leaving a profit of 3 cents over and above all operating expenses and interest on the investment. He figures that an average of 20 pounds of steam per kilowatt hour is all that would be required for actual service.

usually 2 per cent. Combining these losses we find the average commercial efficiency of the alternating plant to be 65 per cent. In stations operating large engines belted to a countershaft the losses are practically the same as given above, except that the loss between the power delivered by the engine and the power delivered to the generators, is usually about 20 per cent., making the commercial or industrial efficiency of the above systems 68 per cent. and 52 per cent., respectively, although there are many cases on record in which the losses are far greater than these, caused by unsoldered joints in the line construction, or defectively designed and operated machinery.

Table No. 1, published recently in *L'Industrie Electrique*, was prepared by Mr. J. Laffargue. I have reproduced it here, as it contains the most complete information regarding foreign central stations that I have been able to secure. The stations are all located in Germany; two of them, those at Elberfeld and Hamburg, being direct current plants, the one at Cologne an alternating station, and those at Barmen, Hamburg and Dusseldorf direct current stations with accumulators as auxiliaries. The table enables us to compare the relative merits of the three systems, and as will be noticed, the alternating station at Cologne produces 71 watt hours per pound of coal, and delivers a kilowatt to the customer for 6.65 cents. The station at Hanover produces the greatest

TABLE NO. 1.

GENERAL DATA.	Direct Current.		Direct Current with Accumulators			Alternating
	Elberfeld.	Hamburg.	Barmen.	Hanover.	Dusseldorf	Cologne.
Fifty watt lamps capable of being supplied from the works.....	10,000.	11,600.	4,500.	12,000.	12,000.	13,600.
Available power in kilowatts.....	12,000.	12,000.	6,500.	23,000.	23,000.	24,000.
Available power in kilowatts.....	500.	580.	225.	600.	600.	680.
EXPENSES OF FIRST ESTABLISHMENT.						
Installation capital, in dollars.....	272,229.96	473,912.90	204,425.53	504,176.51	557,194.58	472,380.58
Specific expenditure, in dollars per kilowatt.....	545.53	816.93	908.50	785.70	926.35	693.55
Specific expenditure, in dollars per lamp.....	24.25	31.43	31.53	39.28	46.32	34.68
RECEIPTS AND EXPENSES.						
Duration of working, in years.....	5.	4.	5.	2.	2.	2.
Total receipts, in dollars.....	46,281.80	112,245.49	23,995.08	65,002.22	54,710.04	54,738.65
Receipts, per cent. of the capital.....	20.5	23.68	11.74	15.8	9.8	11.5
Total expenditure, in dollars.....	17,498.99	26,568.21	8,365.67	18,370.92	15,328.13	20,460.21
Expenditure, per cent. of the capital.....	6.41	5.62	4.9	4.46	2.72	4.07
Rough total profits, in dollars.....	28,782.81	85,677.28	15,629.43	46,631.30	39,381.91	34,278.44
Profits, per cent. of the capital.....	14.09	18.05	7.65	11.34	7.	7.2
EXPENSES—COST.						
Total energy in kilowatt hours, produced.....	313,438.	542,900.	114,996.	452,520.	484,121.	.....
Efficiency of the mains, per cent.	305.794.	513.183.	122.026.	365.114.	337.285.	307.074.
Energy in watt hours per lb. coal, produced.....	97.5	94.5	84.16	80.69	69.68	.....
Salaries in cents, per kilowatt hour, produced.....	2.44	1.80	3.28	1.73	2.65	.....
Cost per kilowatt hour in cents, produced.....	5.57	4.91	5.76	4.05	3.15	.....
Mean selling price in cents per kilowatt hour, including all expenses.....	5.70	5.18	6.85	5.02	4.54	6.65
Charge without deduction for the kilowatt hour, in cents.....	18.29	21.86	19.65	17.29	16.20	17.81
Price for cubic feet of gas, consumption above 3,000 cubic feet, cents.....	17.65	.....	17.65	17.90	20.95	16.96
Price for cubic feet of gas, consumption above 3,000 cubic feet, cents.....	.11	.....	.12	.195	.103	.081
CO-EFFICIENTS OF UTILIZATION—DURATION OF LIGHTING.						
Number of 50 watt lamps installed.....	11,100.	14,000.	7,395.	13,642.	16,623.	15,329.
Maximum power utilized in kilowatts.....	400.	462.	239.	415.	309.	325.
Ratio of power utilized to power available.....	0.80	0.79	0.61	0.48	0.51	0.50
Duration of lighting, in hours, per annum.....	560	693.	325	529.	419.	422.
EMPLOYMENT OF ACCUMULATORS.						
Energy expended for the charge, in kilowatt hours.....	.....	.....	59,573.	1194,733.	279,506.	.....
Energy furnished by the discharge, in kilowatt hours.....	.....	.....	42,584.	154,836.	216,561.	.....
Industrial efficiency of the accumulators, per cent.....	.....	.....	71.5	79.4	77.5	.....
Ratio of energy supplied by the accumulators to the total energy distributed, per cent.....	.....	.....	35.	42.3	68.	.....
Loss in the accumulators, per cent. of the total energy distributed.....	.....	.....	14.	11.	13.	.....

Mr. Crompton's paper having covered practically the ground I had mapped out, has led me to abandon my original plan, in place of which I will present to you to-day the records of a number of central stations operating in this country and Europe from which you can, by comparison, ascertain whether your stations are doing as good service as they should. I will endeavor also to suggest ways in which the earning capacity of stations now running can be increased.

The losses between indicated and electrical horse power in a fairly well designed high speed, belted, direct current station are about as follows: Engines 10 per cent., belts 4 per cent., dynamos 10 per cent., line 10 per cent., making a total commercial efficiency of 70 per cent.

In alternating direct belted plants the losses on engines, belts and dynamos are practically the same as given above. The losses in the primary circuit are usually 5 per cent. Where there are many small transformers and when working underloaded, as they usually are for a large portion of the time in small central stations, the average loss will be about 10 per cent., although when they are working at their rated load they will give an efficiency of 86 per cent. to 95 per cent. The loss on the secondary wiring is

number of watts per pound of coal, viz., 219 and delivers a kilowatt hour to the consumer for 5.2 cents, while the best result of all is shown by the station at Dusseldorf, producing, as it does, 185 watt hours per pound of coal and furnishing a kilowatt to the consumer for 4.54 cents. This would seem to indicate that there is an advantage in using accumulators.

It is also interesting to note that the average commercial efficiency of the accumulators is 76.1 per cent.

Mr. Laffargue adds that the following percentages are allowed for depreciation: $1\frac{1}{2}$ to 2 per cent. on the buildings; 4 to 5 per cent. on the boilers and engines; and 6 per cent. on the accumulators; 8 per cent. on the mains, and 8 to 10 per cent. on the various auxiliaries of the plant. These figures are about correct for practice in this country, except on the accumulator question, and as there are now numerous strong companies entering the field in this country, who are willing to guarantee to maintain battery plants for 10 per cent. per annum, it is possible that we can soon reach the state of perfection in the line that is indicated by these figures.

In comparing the figures on a basis of cost per kilowatt hour delivered to the consumer, the loss in the mains at the various stations should be taken into consideration, as it will be noticed that at Dusseldorf the loss between the station and the consumer

1. A paper read before the Northwestern Electrical Association, St. Paul, Minn., July 19, 1894.

is over 80 per cent., at Hanover 20 per cent, Barmen 15 per cent., while at Hamburg and Elberfeld it is but 5½ and 2½ per cent., respectively. Were these allowances made, it would probably bring the cost at Dusseldorf much below the present figure, but not knowing the exact conditions it was impossible to make the proper allowance in this paper.

The first part of table No. 2 marked "Direct Current," was prepared from reliable information on file in the writer's office, and is the result of the operation of fifteen large direct current stations located in different parts of the United States. The three succeeding parts of the table marked "Direct Current," "Alternating Current" and "Combined Systems," have been compiled from information secured from the report of the committee on statistics of the National Electric Light Association, presented at its last meeting, and figures were chosen only from such stations as seemed to bear evidence of careful compilation. This report did not give the cost of coal per ton, nor the cost of coal per kilowatt hour, but simply gave the watt hours produced per pound of coal. By assuming a price per ton on the coal we have deduced the costs per kilowatt hour which are given, but not having the information necessary to ascertain the operating expenses or fixed charges, the total cost per kilowatt hour delivered to the consumer is omitted.

STATION	R.P. CAPACITY	KILOWATT CAPACITY	HOURS OPERATING PER ANNU.	WATT HRS. PER ANNU.	COAL USED PER ANNU.	COAL COST PER ANNU.	COAL COST PER K.W.H.	COAL COST PER K.W.H. AT 10 CENTS PER TON	COAL COST PER K.W.H. AT 15 CENTS PER TON	COAL COST PER K.W.H. AT 20 CENTS PER TON	TOTAL COST PER K.W.H.
1				684,600		6.23	116	116	176	236	5.28
2				684,600		3.91	86	86	129	172	3.76
3				684,600		2.27	107	107	159	216	3.36
4				777,600		2.97	122	122	182	242	3.72
5				174,120							6.30
6				108,000		2.53	102	102	150	200	4.76
7				126,780		3.12	88	88	132	176	3.92
8				106,700		1.94	71	71	106	142	3.72
9				121,000		1.92	68	68	102	136	3.72
10				121,000		2.80	120	120	180	240	4.76
11				121,000		2.80	120	120	180	240	4.76
12				121,000		2.80	120	120	180	240	4.76
13				121,000		2.80	120	120	180	240	4.76
14				121,000		2.80	120	120	180	240	4.76
15				121,000		2.80	120	120	180	240	4.76
16				121,000		2.80	120	120	180	240	4.76
17				121,000		2.80	120	120	180	240	4.76
18				121,000		2.80	120	120	180	240	4.76
19				121,000		2.80	120	120	180	240	4.76
20				121,000		2.80	120	120	180	240	4.76
21				121,000		2.80	120	120	180	240	4.76
22				121,000		2.80	120	120	180	240	4.76
23				121,000		2.80	120	120	180	240	4.76
24				121,000		2.80	120	120	180	240	4.76
25				121,000		2.80	120	120	180	240	4.76
26				121,000		2.80	120	120	180	240	4.76
27				121,000		2.80	120	120	180	240	4.76
28				121,000		2.80	120	120	180	240	4.76
29				121,000		2.80	120	120	180	240	4.76
30				121,000		2.80	120	120	180	240	4.76
31				121,000		2.80	120	120	180	240	4.76
32				121,000		2.80	120	120	180	240	4.76
33				121,000		2.80	120	120	180	240	4.76
34				121,000		2.80	120	120	180	240	4.76
35				121,000		2.80	120	120	180	240	4.76
36				121,000		2.80	120	120	180	240	4.76
37				121,000		2.80	120	120	180	240	4.76
38				121,000		2.80	120	120	180	240	4.76
39				121,000		2.80	120	120	180	240	4.76
40				121,000		2.80	120	120	180	240	4.76
41				121,000		2.80	120	120	180	240	4.76
42				121,000		2.80	120	120	180	240	4.76
43				121,000		2.80	120	120	180	240	4.76
44				121,000		2.80	120	120	180	240	4.76
45				121,000		2.80	120	120	180	240	4.76
46				121,000		2.80	120	120	180	240	4.76
47				121,000		2.80	120	120	180	240	4.76
48				121,000		2.80	120	120	180	240	4.76
49				121,000		2.80	120	120	180	240	4.76
50				121,000		2.80	120	120	180	240	4.76
51				121,000		2.80	120	120	180	240	4.76
52				121,000		2.80	120	120	180	240	4.76
53				121,000		2.80	120	120	180	240	4.76
54				121,000		2.80	120	120	180	240	4.76
55				121,000		2.80	120	120	180	240	4.76
56				121,000		2.80	120	120	180	240	4.76
57				121,000		2.80	120	120	180	240	4.76
58				121,000		2.80	120	120	180	240	4.76
59				121,000		2.80	120	120	180	240	4.76
60				121,000		2.80	120	120	180	240	4.76
61				121,000		2.80	120	120	180	240	4.76
62				121,000		2.80	120	120	180	240	4.76
63				121,000		2.80	120	120	180	240	4.76
64				121,000		2.80	120	120	180	240	4.76
65				121,000		2.80	120	120	180	240	4.76
66				121,000		2.80	120	120	180	240	4.76
67				121,000		2.80	120	120	180	240	4.76
68				121,000		2.80	120	120	180	240	4.76
69				121,000		2.80	120	120	180	240	4.76
70				121,000		2.80	120	120	180	240	4.76
71				121,000		2.80	120	120	180	240	4.76
72				121,000		2.80	120	120	180	240	4.76
73				121,000		2.80	120	120	180	240	4.76
74				121,000		2.80	120	120	180	240	4.76
75				121,000		2.80	120	120	180	240	4.76
76				121,000		2.80	120	120	180	240	4.76
77				121,000		2.80	120	120	180	240	4.76
78				121,000		2.80	120	120	180	240	4.76
79				121,000		2.80	120	120	180	240	4.76
80				121,000		2.80	120	120	180	240	4.76
81				121,000		2.80	120	120	180	240	4.76
82				121,000		2.80	120	120	180	240	4.76
83				121,000		2.80	120	120	180	240	4.76
84				121,000		2.80	120	120	180	240	4.76
85				121,000		2.80	120	120	180	240	4.76
86				121,000		2.80	120	120	180	240	4.76
87				121,000		2.80	120	120	180	240	4.76
88				121,000		2.80	120	120	180	240	4.76
89				121,000		2.80	120	120	180	240	4.76
90				121,000		2.80	120	120	180	240	4.76
91				121,000		2.80	120	120	180	240	4.76
92				121,000		2.80	120	120	180	240	4.76
93				121,000		2.80	120	120	180	240	4.76
94				121,000		2.80	120	120	180	240	4.76
95				121,000		2.80	120	120	180	240	4.76
96				121,000		2.80	120	120	180	240	4.76
97				121,000		2.80	120	120	180	240	4.76
98				121,000		2.80	120	120	180	240	4.76
99				121,000		2.80	120	120	180	240	4.76
100				121,000		2.80	120	120	180	240	4.76
101				121,000		2.80	120	120	180	240	4.76
102				121,000		2.80	120	120	180	240	4.76
103				121,000		2.80	120	120	180	240	4.76
104				121,000		2.80	120	120	180	240	4.76
105				121,000		2.80	120	120	180	240	4.76
106				121,000		2.80	120	120	180	240	4.76
107				121,000		2.80	120	120	180	240	4.76
108				121,000		2.80	120	120	180	240	4.76
109				121,000		2.80	120	120	180	240	4.76
110				121,000		2.80	120	120	180	240	4.76
111				121,000		2.80	120	120	180	240	4.76
112				121,000		2.80	120	120	180	240	4.76
113				121,000		2.80	120	120	180	240	4.76
114				121,000		2.80	120	120	180	240	4.76
115				121,000		2.80	120	120	180	240	4.76
116				121,000		2.80	120	120	180	240	4.76
117				121,000		2.80	120	120	180	240	4.76
118				121,000		2.80	120	120	180	240	4.76
119				121,000		2.80	120	120	180	240	4.76
120				121,000		2.80	120	120	180	240	4.76
121				121,000		2.80	120	120	180	240	4.76
122				121,000		2.80	120	120	180	240	4.76
123				121,000		2.80	120	120	180	240	4.76
124				121,000		2.80	120	120	180	240	4.76
125				121,000		2.80	120	120	180	240	4.76
126				121,000		2.80	120	120	180	240	4.76
127				121,000		2.80	120	120	180	240	4.76
128				121,000		2.80	120	120	180	240	4.76
129				121,000		2.80	120	120	180	240	4.76
130				121,000		2.80	120	120	180	240	4.76
131				121,000		2.80	120	120	180	240	4.76
132				121,000		2.80	120	120	180	240	4.76
133				121,000		2.80	120	120	180	240	4.76
134				121,000		2.80	120	120	180	240	4.76
135				121,000		2.80	120	120	180	240	4.76
136				121,000		2.8					

sents the electrical horse power required by the arc and incandescent lights, and the lower dotted line represents the electrical horse power required by the arc lights alone.

Referring to table No. 3, it will be observed that the test began at 10:30 a. m. and continued for 24 hours. As the load in this station varied greatly, one of the objects of the test was to ascertain the cost of producing power during the different periods, and the right hand column in the table shows the total cost per kilowatt hour of the power thus produced.

The railway portion of this station operates from four to six cars, and during the time of the test but four cars were in operation. The cars started at 5:50 a. m. and ran until 12 o'clock midnight, and the lighting load was added as indicated by the figure.

The division in the table shows the principal variation in the load, and it is interesting to note the change in cost per kilowatt hour produced, depending, of course, as it does, upon the quantity of current delivered, as the cost remains practically constant, with the exception of the fuel. From 7:20 a. m. to 4:10 p. m., when the railway load is being operated, the cost averages 3.1 cents per kilowatt hour, and from 12 o'clock midnight until 5 a. m. the cost per kilowatt hour is 3.96 cents, while during the heavy load, from 5 p. m. until midnight, the average cost per kilowatt hour is but 1.75 cents, and after deducting the labor, which is a fixed charge, the total cost per kilowatt hour for full load is but $1\frac{1}{2}$ cent. After allowing for salaries, office expenses, loss in lines and depreciation in the plant, the figures show that this station is delivering current to the consumer for 6.4 cents per kilowatt hour, which corresponds fairly well with the figures given in table No. 2.

With a little calculation we see that this plant could have

out the Southern and Western states where such plants could be installed to advantage.

In closing this paper I will briefly call attention to the approximate results we are now getting from the different portions of power stations, and what we ought to expect from stations designed in the future.

First—Boilers—A large number of stations running now are using boilers with plain furnaces, from which they secure an evaporation of 5 pounds of water per pound of coal. By the introduction of water tube or internally fired boilers or tubular boilers set in improved furnaces, we should secure an evaporation of 8 pounds of water per pound of the same fuel.

Second—Engine and Generators—While we now get an average commercial efficiency of 60 to 70 per cent. in direct belted plants and 50 to 60 per cent. in those using shafting, we can increase these efficiencies to 70 and 75 per cent., respectively, by the adoption of fewer and larger direct coupled units. This will not only reduce the cost of fuel and labor but will decrease the amount of real estate required and make the total investment less.

Third—While Europeans have recognized the advantage of the use of accumulators with batteries as auxiliaries in central station work, we have been slow to see this advantage, but the tendency now among American engineers and central station men is to look with favor upon this adjunct, and as there are many cases wherein a battery plant as an auxiliary can be made to pay well, the probability is that we shall see in the next five years many such plants installed. With a properly designed direct connected plant we may reasonably expect to deliver a kilowatt hour to the consumer in stations having a capacity of not over 1,500 kilowatts for 5 cents

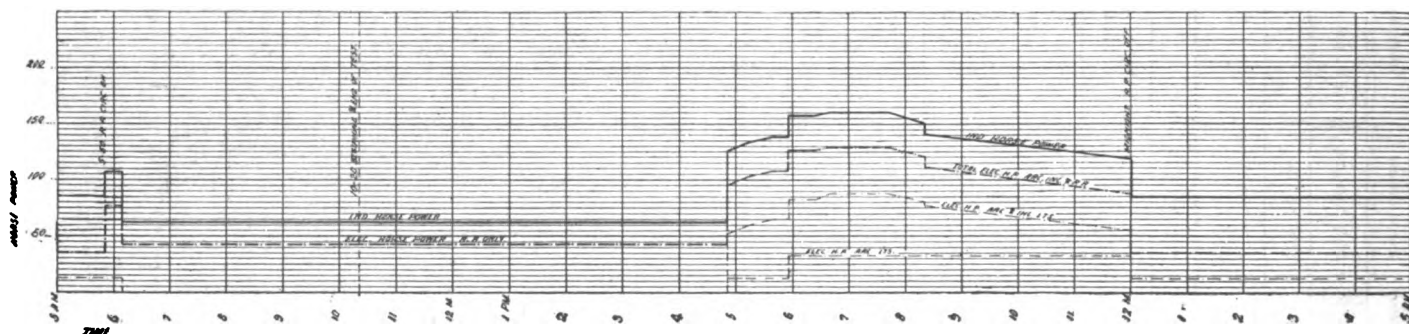


FIG. 1.—LOAD DIAGRAM.

furnished 681 additional kilowatt hours, or over 90 additional horse power in motors, for ten hours from 6 a. m. to 6 p. m., for an additional cost of but \$9.00 for fuel, or at a cost of one cent per horse power hour, and as a price of two cents per horse power hour can be obtained for motor work, there would be an additional revenue of \$9 per day added to this station, assuming that all the motors were running fully loaded.

As a matter of fact the following statement shows approximately the average amount of power demanded from electric motors when running on various kinds of work: Wood working machinery, 40 per cent. of rated capacity of machines in the plant; elevators, 80 per cent.; printing presses, 55 per cent.; machine shops, 40 per cent. or an average of about 55 per cent. On this basis this plant could drive safely 160 horse power in addition to its present railroad load, which, at 2 cents per horse power hour would bring an additional revenue of \$38 per day, and deducting \$9, the cost of fuel, leaves \$24 per day additional net profit which this plant can be made to earn, provided the full capacity of the motors is paid for.

In case the additional load for electric motors is not available this extra 90 horse power could be utilized in driving an ice plant. In practice it takes about 2 horse power 24 hours to produce a ton of ice, and on this basis the available capacity of this plant would produce 20 tons of ice, which would sell for at least \$3 per ton, making an additional revenue of \$60 per day for the plant, and after deducting for extra fuel, labor and depreciation, leaves \$40 per day.

The cost of ice-making plants is about as follows, per ton of output in 24 hours:

1 ton.....	\$2,700
2 ".....	2,650
6 ".....	1,216
12 ".....	993
20 ".....	875
40 ".....	800

While the addition of an ice plant to an electric light plant may not be particularly desirable in stations throughout the Northwest, there is no doubt that there are many stations through-

per kilowatt hour, which includes total cost of production and depreciation on the plant, but excludes interest on the investment and profit, assuming that a good quality of bituminous coal can be had for \$2.50 per ton. In larger stations with cheaper fuel the cost can be brought to $3\frac{1}{2}$ cents.

"LET YOUR LIGHT SO SHINE, ETC."

It is unusual for a corporation enjoying a city franchise to use the supplies with which it furnishes the city as an advertising medium, but that is what a Brooklyn electric light company is doing. On the glass globe surrounding each light the name of the company is lettered, and when the lights are in working order the lettering is reflected on the sidewalk. Commissioner White, of the City Works Department, said yesterday that this particular company's service had been somewhat irregular and defective and that it seemed poor policy to advertise its name under the circumstances.—*N. Y. Morning Advertiser*.

SPORTS OF BROOKLYN BOYS.

In some parts of Brooklyn, the street boys make life happy for the motormen by dropping well-dressed dummies along the track in the dusk, just in front of advancing cars. At the moment when the motorman in an agony of despair has managed to bring his car to a sharp halt, the dummy is jerked away by a string. It is great sport, and the boys have no trouble in begging, borrowing or stealing the necessary garments. Once in a while the boys get run over, but that is different, and half a dozen newspapers talk themselves black in the face about the deadly trolley, the juggernaut and the sweet Brooklyn innocents.

PAPER TELEGRAPH POLES.

It is stated that paper telegraph poles are the latest development of the art. These poles are made of paper pulp, in which borax, tallow, etc., are mixed in small quantities. The pulp is cast in a mold, with a core in the centre, forming a hollow rod of the desired length, the cross pieces being held by key-shaped wooden pieces driven in on either side of the pole. Many advantages are claimed for them.

LEGAL NOTES.

INCANDESCENT LAMP LITIGATION.

EDISON ELECTRIC LIGHT CO. ET AL. V. STAR ELECTRIC LAMP CO.
ET AL.

The opinion filed by Judge Seaman of the Circuit Court of the United States, Northern District of Illinois, at Chicago, August 1st, in the case of the Edison Electric Light Company and the Edison General Electric Company against the Star Electric Lamp Company, David J. Kennedy, Albert S. Terry and Franklin S. Terry, is given in full below.

This hearing is upon a rule to show cause why an injunction *pendente lite* should not issue against the defendants according to the prayer of the bill of complaint.

The rule was entered, with a temporary restraining order, June 9, 1894, when the bill was filed alleging infringement of letters patent No. 223,898, issued to Thomas A. Edison, January 27, 1880, for an incandescent lamp. The validity of this patent is not questioned here, and for the purposes of this motion at least must be taken as well settled by repeated adjudications.

Infringement is unquestioned if the patent is alive with reference to the defendants.

The only defense is that which was set up and maintained recently in the Circuit Court for the Northern District of Ohio, in the case of the Edison Electric Light Company against the Buckeye Electric Company (59 Fed. Rep., 691) viz., that the complainants are estopped from asserting, as against these defendants, that the patent extends beyond November 10, 1893, because a purported amendment in the Patent Office, dated December 18, 1893, appears to limit its existence to the term of a "British patent for fourteen years, dated November 10, 1879." It is undisputed that this amendment did not correctly show the date from which the British patent took effect, that the proceeding was taken under a mistaken view, and was not within the jurisdiction of the Patent Office, that it was expunged on March 13, 1893, and adjudications have settled that it was void and did not limit the term of the patent.

The opinion by Judge Ricks, in the case cited, shows careful consideration in holding an estoppel, and taking it in connection with two subsequent opinions by the same learned court, whereof certified copies have been furnished for this hearing—one upon reconsideration of the former case, after further showing, reaffirming the first decision, and the other, in a case of the same complainants against the Universal Electric Company, distinguishing and explaining the prior decisions, and holding the estoppel not applicable, because the defendant "began business as an infringer" and made its further investments "after the revocation of March, 1893," would be strongly persuasive of a similar ruling for the purpose of this motion, if analogous situations of the parties and facts are shown.

The defendant, the Star Electric Lamp Company, is a recent incorporation, having legal existence only from March 18, 1893, which would be subsequent to the cancellation in the Patent Office of the alleged amendment of the patent.

Within its own rights, therefore, it is clear that this corporation is barred from any of the benefits of estoppel which might arise in favor of one taking action and making large investments before the cancellation.

It would be ruled by the case of the Universal Electric Company, last cited, and the well-settled principles there announced.

But the defendants contend that this corporation is simply an outgrowth and continuation of another corporation, the Sunbeam Incandescent Lamp Company, or, as stated in their brief, is "a mere creature of the Sunbeam company," having the same officers, stockholders and managers, and "is in fact the same company under another name," and being founded upon "the same investment and interest," is entitled to any benefits of estoppel which would work in favor of the parent company.

This statement may well be accepted as true, in the identity of stockholders, management and investment, but the two companies have nevertheless separate corporate entities.

Whether this identity of interests would enable the defendant corporation to draw to itself any benefits of estoppel which may have existed in favor of the Sunbeam company, or whether the individual defendants, who are made parties as officers of the Star company, could avail themselves of any such defenses vesting in the Sunbeam company, does not require decision here, because I am clearly of the opinion that the Sunbeam company deprived itself of that defense, if it ever existed.

The Sunbeam Incandescent Lamp Company was organized in February, 1890, and made considerable investments for the manufacture of incandescent lamps, and entered upon their manufacture.

Certain of its stockholders received by mail a notice from attorneys of complainant that the courts had sustained the Edison patent, and that infringers would be vigorously prosecuted, but

with this notice was a copy of the patent, accompanied by the certificate of amendment of December 18, 1893, and relying upon this as limiting the term of the patent to November 10, 1893, further investments were made.

On January 14, 1893, the complainants filed a bill against the Sunbeam Company and its officers for infringement of the patent, and obtained a temporary restraining order, but the hearing upon a rule to show cause why the injunction should not continue *pendente lite* was postponed from time to time until May 17, 1893, when an agreement was entered into between the parties reciting infringement by the Sunbeam company, their desire to avoid litigation and damages and necessity to complete about 150,000 lamps then in process, and license was thereupon given the complainant for that purpose upon terms specified and accountings to be rendered. It was agreed by the Sunbeam Company that upon the completion of the lamps referred to "it would refrain from manufacturing infringing incandescent lamps during the life of the patents," their validity was admitted and consent stipulated to a decree in the action against the defendant company "as prayed for in the bill of complaint."

The complainant waived all costs, damages and profits.

The manufacture under this agreement has continued, with accountings, as provided for, and is still progressing. On October 2, 1893, the final decree was duly entered with perpetual injunction, but the individual defendants, Kennedy and Terry, were dismissed from the bill, pursuant to an understanding to that effect explained by affidavits as intending that there should be no interference with the manufacture of non-infringing lamps designed by them in which gas was substituted for a vacuum.

The defendants claim that they entered into the agreement in the belief, founded on the amendment, that "the life of the patent would terminate November 10, 1893," although it is admitted that complainants then asserted otherwise, and their bill of complaint, on which the stipulation and decree were entered, alleged a right for seventeen years from the date of the patent.

It is significant, also, that the answer of the defendants in that case, filed May 8, 1893, made no defense or assertion of this estoppel, which if well founded would have terminated any right to an injunction before final hearing could possibly be reached.

This agreement bound the corporation and its officers and stockholders for all interests and rights which were there involved; all prior rights and equities must be held merged in it to the extent imported by its terms.

Any belief which may have been entertained by either of the parties relative to the duration of the patent cannot prevent the operation of the settlement for the actual life of the patent as therein expressed; it leaves the extent to be determined according to the fact and not upon any estoppel which might have been invoked before the settlement. This is a clear case for the application of an estoppel against an estoppel, which "setteth the matter at large," as stated by Lord Coke, *Branson v. Wirth*, 17 Wall., 32. If, therefore, the showing made by the defense would primarily have constituted an estoppel in favor of the Sunbeam company through investment by its stockholders in reliance upon it—which is not here decided—that company was foreclosed by its agreement and acts and the defendant corporation, which is masquerading here as a new company, with all the interests of the old one, cannot take the benefits of the old without the attendant burdens.

The complainant shows clear right to protection by an injunction *pendente lite*. The fact that the defendants have a large investment in a plant which will be rendered idle by an injunction cannot be permitted to turn the scales against a case so made out.

The individual defendants are properly made parties as officers of the corporation—president, treasurer, and secretary, respectively—and, while an injunction against the corporation is binding upon its officers, it is proper to name them in the order or decree. *The history of this litigation shows the value of such practice.*

An injunction will issue against all of the defendants according to the prayer of the bill.

PERSONAL.

MR. HERBERT LAWS WEBB, contributes to the September *Scribner* a short story with a very original motive. The action takes place in a lonely cable house at the end of one of the cables in an obscure South American port.

OBITUARY.

C. H. RUDD.

WE regret to announce the death, on August 11, of Mr. C. H. Rudd, due to injuries received in the accidental explosion of a new explosive material of which he was the inventor.

Mr. Rudd, who had been one of the electrical staff of the Western Electric Co. for nearly twenty years, was the inventor of numerous electrical devices and enjoyed the confidence and esteem of all who came in contact with him. He leaves a widow and a son of 19.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED AUGUST 7, 1894.

Alarms and Signals:—

Railway Signaling Device, W. Daves, Jersey City, N. J., 524,088. Filed Aug. 8, 1892.

An automatic electric crossing or block signal system for steam railways. *Annunciator*, P. Weber, Nuremberg, Germany, 524,098. Filed Jan. 16, 1894.

Electric Signal for Steamboats, R. H. Gruschow, Chicago, Ill., 524,202. Filed Jan. 30, 1894.

Submarine Signaling, L. I. Blake, Lawrence, Mass., 524,239. Filed Dec. 22, 1893.

A system of telephonic communication with light ships utilizing the anchor cable as part of the metallic circuit.

Conductors, Conduits and Insulators:—

Waterproof Insulated Electric Conductor, D. Macfarlan, Philadelphia, Pa., 524,066. Filed May 17, 1894.

Consists of a conductor having a cord of fire-proof material saturated with an insulating substance wound about it and covered with an outer layer of rubber cloth.

Supporting Insulator for Electric Wires, L. S. Beardsley, Naugatuck, Conn., 524,100. Filed June 11, 1894.

Relates to a device for holding in place the usual form of glass insulator.

Distribution:—

Electric Transformer, J. J. Wood, Fort Wayne, Ind., 524,188. Filed March 19, 1894.

Employs a laminated iron core with a ventilating space through it maintained by means of a corrugated sheet interposed between the laminæ.

Dynamos and Motors:—

Electrical Motor, H. B. Porter, New York, 523,995. Filed Dec. 5, 1893.

Employs an armature consisting of two pivoted arms operating in combination with the magnet but on opposite sides of the latter, and a lever for transmitting the power from the pivoted arms.

Dynamo-Electric Machine, G. Rennerfelt, Lynn, Mass., 523,998. Filed March 6, 1894.

Claim 1 follows:

The combination of a magnet with a divided core, a series of rotating conductors interposed between the parts thereof, and means for electrically connecting said conductors in series.

Electric Motor, F. O. Whitmore, Lynn, Mass., 524,011. Filed May 3, 1893.

Employs a field magnet frame consisting of a top and base bolted together with internal extensions and removable field magnet cores clamped between the meeting edges of the top and base, the polar extensions forming consequent poles.

Dynamo Electric Machine, R. Elckemeyer, Yonkers, N. Y., 524,020. Filed Oct. 7, 1891.

Employs counter field coils adapted to strengthen or weaken the magnetism of symmetrically arranged cheek pieces of separate electro magnets, according to the direction in which the machine is operated for maintaining a permanent line of commutation regardless of variations in speed or load.

Dynamo Electric Machine, W. B. Sayers, Glasgow, Scotland, 524,119. Filed Jan. 6, 1894.

Claim 1 follows:

An armature for a dynamo electric machine in which the sections of the armature winding are connected to the commutator sections by commutator coils, portions of each of which are located on opposite sides of a section of the said winding to one end of which said commutator coil is connected.

Regulator for Dynamo Electric Machines, T. A. Edison, Menlo Park, N. J., 524,136. Filed Nov. 11, 1891.

Employs an electro magnet in the main circuit and a variable resistance in the field of force circuit, the magnet varying the resistance of the field circuit as it is more or less energized.

Galvanic and Thermo-Electric Batteries:—

Primary Battery, W. Walker, Jr., Birmingham, Eng., F. R. Wilkens, Handsworth, Eng., and J. Lones, Smethwick, Eng., 524,229. Filed Feb. 27, 1894.

A single liquid battery employing amalgamated zinc as the positive element and carbon as the negative and an electrolyte of a strong solution of caustic soda or caustic potash or the like.

Primary Voltaic Cell, W. Walker, Jr., Birmingham, Eng., & F. R. Wilkens, Handsworth, Eng., 524,291. Filed June 4, 1894.

Similar to No. 524,229.

Heating:—

Electric Heater, J. F. Kester, La Grange, Ill., 524,062. Filed Apl. 29, 1893.

Consists of a slab of soapstone containing a resistance medium arranged in a cavity of the stone.

Lamps and Appurtenances:—

Electric Arc Lamp, G. G. Stout, Parkersburg, W. Va., 524,003. Filed June 19, 1894.

Employs a transparent tube surrounding the carbon and a telescopic metallic extension sliding in connection with the feeding mechanism.

Electric Arc Lamp, W. S. Pendleton, New York, 524,116. Filed Mch. 6, 1894.

Relates especially to certain details of the feeding mechanism.

Metal Working:—

Process of Electric Metal Working, H. Lemp, Lynn, Mass., & W. S. Moody, Chelsea, Mass., 523,966. Filed Oct. 20, 1890.

Claim 1 follows:—

The combination with transformers having their opposite poles arranged respectively on intersecting lines, of means of supplying the primaries of said transformers respectively with currents differing in phase.

Electric Welding Machine, H. Lemp, Lynn, Mass., 523,967. Filed Jan. 19, 1891.

The invention consists essentially in making the work holding blocks independent of the contact terminals.

Miscellaneous:—

Electric Pump, F. W. Merritt & A. R. Roe, Duluth, Minn., 524,044. Filed Nov. 6, 1893.

Electric Hand Appliance for Massage, A. J. Speare, Thayer, Mo., 524,120. Filed April 16, 1894.

Apparatus for Purifying Water or Aging Liquors, R. C. Turner, Steubenville, O., 524,121. Filed Feb. 6, 1894.

Thermo-Electric Volatilizing Obtunder, O. B. Bachman, Minneapolis, Minn., 524,156. Filed April 6, 1893.

Circuit-Breaker for Electrotherapeutic Apparatus, L. W. Downs, Providence, R. I., 524,165. Filed Jan. 21, 1893.

Railways and Appliances:—

Trolley Wire Support, L. Yakel, Allegheny, Pa., 524,014. Filed Apl. 15, 1893.

Relates especially to means of insulating the parts of the support by a series of alternate asbestos and mica discs.

Trolley for Electric Cars, G. C. Bourdreaux, Peoria, Ill., 524,017. Filed Mch. 12, 1894.

Relates especially to a self-oiling device for trolley wheels.

Conduit Electric Railway, R. M. Hunter, Philadelphia, Pa., 524,025. Filed Nov. 30, 1893.

Claim 2 follows:—

In an electric railway, the combination of a working conductor arranged along the railway, an electrically propelled vehicle having a pivoted truck, and a collector suspended from said truck substantially below its pivoted point and making contact with the conductor.

Motor Suspension for Railway Work, E. W. Rice, Jr., Lynn, Mass., 524,117. Filed Aug. 15, 1890.

A supporting frame sleeved on the car axle and consisting of two side and two cross pieces one of which forms the yoke for the field magnet.

Insulating Trolley Wire Support, F. M. Zimmerman, Detroit, Mich., 524,222. Filed Nov. 2, 1893.

Electric Railway Pole Ratchet, T. J. McTighe, New York, 524,222. Filed Jan. 23, 1893.

Trolley Wire Circuit Breaker, T. J. McTighe and S. W. Childs, New York, 524,223. Filed Jan. 23, 1893.

Consists of two end castings united by two lateral parallel insulating rods.

Switches and Cut-Outs:—

Rosette for Electric Light Wires, C. N. Hammond, Boston, Mass., 524,109. Filed Dec. 7, 1893.

Telegraph:—

Printing Telegraph Instrument, J. H. Rogers, Bladensburg, Md., 524,118. Filed Dec. 12, 1893.

Relates principally to the mechanism for receiving and producing telegraphic messages.

Telephones and Apparatus:—

Telephone Annunciator and Call Bell, F. G. Warrell, Philadelphia, Pa., 524,008. Filed June 25, 1891.

A combined system of telephone and call bell annunciator for hotels, etc., where connection is made by the adjustment of a switch at the switchboard, and where the respective terminals may be connected with the annunciator and central telephone on independent circuits.

Variable Resistance Medium for Telephones, W. W. Jacques, Newton, Mass., 524,172. Filed May 14, 1894.

Claim 1 follows:

A microphone element composed of boron having electrical conductivity.

Variable Resistance Medium for Telephones, W. W. Jacques, Newton, Mass., 524,173. Filed May 14, 1894.

Claim 1 follows:

A microphonic element composed of silicon having electrical conductivity.

LETTERS TO THE EDITOR.

STREET LIGHTING BY ALTERNATING ARCS.

IN the issue of THE ELECTRICAL ENGINEER of July 4, in a paper read by Mr. Armstrong before the Chicago Electrical Association, he calls attention to several good points in favor of alternating arcs for street lighting. As usual, some one jumps all over Mr. Armstrong a few days later and tells us all about it. But in this case there were two, Mr. R. E. Richardson and Mr. S. G. Neiler, in the issue of THE ELECTRICAL ENGINEER of July 25, 1894. But in their article they make several very misleading statements, a great many more than Mr. Armstrong, and, what makes matters worse and seem queerer, is, that it should take two full-grown men to do so little.

Messrs. Richardson and Neiler say: "To avoid argument (this is very kind of them) we will agree that, under certain conditions, there might be a saving in cost of conductors in favor of the alternating system, but such conditions would naturally be special cases." Here Messrs. Richardson and Neiler must agree that there are a great many special cases to be looked after and taken care of. They next state that because of an arc lamp being constructed under broad patents it would not be admissible; and, farther on, they say that Mr. Armstrong has overlooked the fact that there is no double carbon all night alternating arc lamp upon the market.

Here I wish to state that Messrs. Richardson and Neiler have made a great error, a mis-statement in the extreme, because there are alternating arc lamps upon the market that are guaranteed to burn 24 hours, and at 450 watts, and to give 2,000 C. P., and, still more, they are of the highest standard and burn equally well on either high or low frequency and burn practically noiselessly.

Farther on Messrs. Richardson and Neiler state that in case anything goes wrong with series or high tension arc lamps, they are provided with automatic cut-outs. This is all true, but they do not state what they cut in when they cut out; and, where an objection arises to putting in a new fuse in cases where alternating arcs are run in multiple, one should not lose sight of the fact that automatic cut-outs are a great deal more liable to blow out than fuses, besides being a hundred times more expensive to replace.

Next they say that Mr. Armstrong also neglects the fact that fuses do not always perform the service for which they were intended. This verse is remarkable, simply astonishing. Wonder how about automatic cut-outs. In another passage they say it has been known that careless linemen have often put in copper wire for fuses, and they go on to state that where such things do occur it virtually means the destruction of both arc lamp and transformer. The above is another very misleading and untrue statement. I will also add here that if copper wire fuses were used more universally there would be a great deal less trouble all round.

BUFFALO BILL.

Trade Notes and Novelties

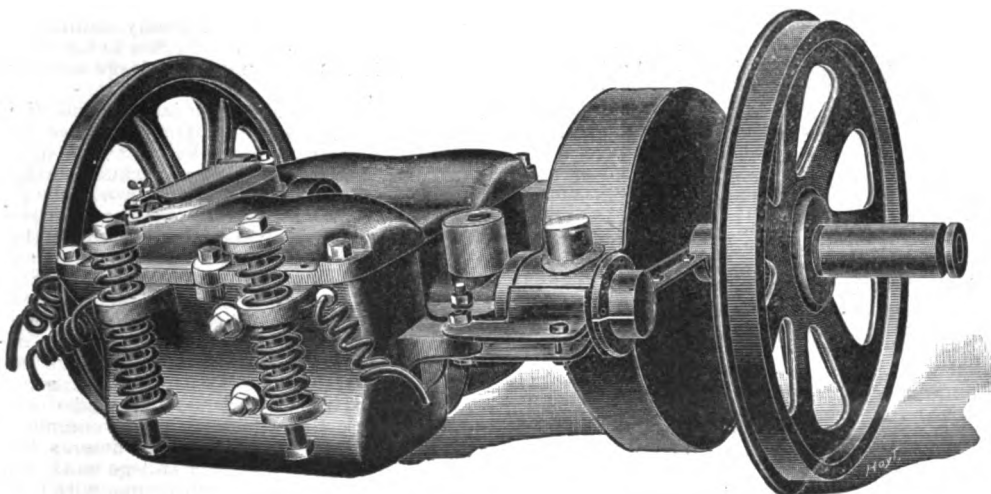
AND MECHANICAL DEPARTMENT.

NEW "STEEL" RAILWAY MOTOR.

WE illustrate in the accompanying engravings the improved type "C" motor and series parallel controller, manufactured by the Steel Motor Company, of Cleveland, O. This company has been engaged for a number of years in supplying repairs for all types of motors, and is therefore in a position to observe the undesirable features of the various types, which were naturally avoided in the designing of its own. The aim of the designers has been to produce, first of all, a substantial, well-built motor of few parts, simple in construction and easily understood, with all parts requiring renewal so made as to have great wearing surface, and replaceable at small cost.

The motor of this company, shown herewith, is claimed to possess, not only these desirable features, but to also be high in electrical and mechanical efficiency, and to be the lightest motor (per unit of actual horse power delivered to the axle) on the market. The armature is of the drum type, and contains ninety-nine coils wound in slots, the wire being carried well below the surface of the core; ample provision is made for perfect insulation. The fields are wound on metal shells, thoroughly insulated, and by an ingenious arrangement of the pole pieces, the armature of either of the fields can be removed independent of the others.

The manufacturers have not, until recently, pushed this motor to the front, preferring to await the test of actual service; but now, after two years' operation under various conditions on some of the most difficult roads in the country, in which the



RAILWAY MOTOR OF THE STEEL MOTOR CO.

motors have won unstinted praise, they offer their equipment for the consideration of the street railway fraternity. Among other equipments this company has filled two orders, aggregating 100 motors, for the Cleveland Electric Railway Company, and has just completed its fourth order for the Allentown & Lehigh Valley Traction Company. The company is now working on 120 motors for the Nassau Electric Company, of Brooklyn, N. Y., 10 motors for Lorain Street Railway, of Lorain, Ohio, 50 motors for Yonkers, N. Y., as well as on a number of smaller orders for different parts of the country.

NEW SIEMENS & HALSKE PLANT.

Immediately upon the destruction of their works at Chicago by fire on August 1, the Siemens & Halske Company of America cast about for a factory equipped to continue the manufacture of their apparatus and it is now announced that they have secured the large and well equipped shops of the defunct Grant Locomotive Works, at Cicero, near Chicago. The works include large machine shops, foundry, traveling cranes, etc., and are thus eminently adapted for handling the heaviest work. There are also rumors of a proposed consolidation of the Siemens & Halske company with the Grant Locomotive Works and the Wells-French Co., car builders, of Chicago.

MR. JOHN DICK, of the Phoenix Iron Works, Meadville, Pa., was in Chicago last week looking after some important contracts closed by their Western office.

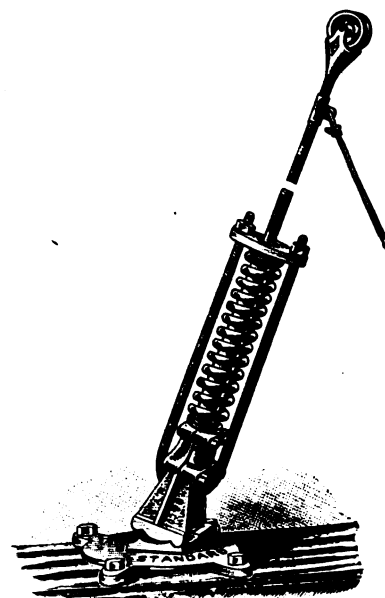
CHLORIDE ACCUMULATOR STORAGE BATTERY STATION FOR NEW YORK.

THE NEW YORK EDISON ELECTRIC ILLUMINATING COMPANY has contracted with the Electric Storage Battery Company of Philadelphia for a large storage battery installation, to consist of 150 elements of Chloride accumulators, Type G, 41 plates, having a capacity of 8,000 ampere hours at 150 volts, at normal rates, or a total capacity of 1,200 kilowatt hours.

The installation will be furnished with the most modern and complete appliances for the control and operation of the battery, and everything possible will be done to make it a model, and at the same time the most modern and complete battery plant ever installed. The battery is to be installed immediately, to be ready for the heavy winter load.

J. H. BUNNELL & CO'S RAILWAY CATALOGUE.

J. H. BUNNELL & Co., 76 Cortlandt street, have issued a twenty-eight page catalogue, closely printed, and devoted to the more recent electric railway appliances manufactured and introduced by them. Many new and interesting pieces of apparatus find place upon its pages, and the cuts are so carefully made that but little description is necessary. The accompanying illustration shows the "Standard" trolley, to which the firm call special attention, and for which they anticipate a ready sale. It has a very even upward pressure in all its operative positions, and its simplicity of



BUNNELL'S "STANDARD" TROLLEY.

construction greatly reduces the likelihood of trouble. The catalogue is concise, and will be valuable to those interested in electric railway construction.

ASSIGNMENT OF QUEEN & CO.

WE regret to announce the assignment of Queen & Co., Incor., of Philadelphia. In a circular issued to their creditors, they state that owing to the depression during the last year, and the difficulty in making collections, they have been compelled, in the interests of all their creditors, to make an assignment, without preference, for their benefit, to their present manager, Mr. John G. Gray.

A meeting of the creditors for the purpose of determining the best method of disposing of the assets of Queen & Co., Incor., was called at the office of the attorneys for the assignee, Messrs. Jones & Carson, Rooms 426-431 Drexel Building, Philadelphia, on August 18th.

THE NATIONAL CONDUIT MANUFACTURING CO.

The National Conduit Manufacturing Company seem to be doing a large part of the underground work going forward this year. They have just closed a contract with the Boston Electric Light Company, of Boston, for all their subway work for this year; they have also contracted with the Nebraska Telephone Company for all the conduits for the Lincoln subway which is to be built this year.

THE FALKENAU ENGINEERING COMPANY, LTD.



A. FALKENAU.

The Falkenau Engineering Company, Ltd., is prepared to undertake work in any part of the country, and to furnish estimates or bids upon the same, and will take pleasure in corresponding or conferring with all those contemplating work of the character outlined above.

The technical education of the members of this firm, supplemented by an engineering and business experience, covering a period of from five to fifteen years, is a guarantee that all work entrusted to them will receive competent attention and be performed in a thorough and satisfactory manner.

A few words regarding the members of the new firm may not be amiss.

MR. A. FALKENAU was born in New York City in 1856. After finishing the Freshman year at the College of the City of New York, Mr. Falkenau left college and entered the shops of the Delamater Iron Works, where he served a regular machinist's apprenticeship, keeping up his studies, however, by attending the evening classes at the Cooper Institute. Before completing his apprenticeship, Mr. Falkenau was employed on important work in connection with the Ericsson submarine torpedo, and had charge of the construction and erection of several yacht engines. In the Fall of 1875 he entered the Course in Mechanical Engineering at Cornell University, where he graduated in 1878 as one of the honor men. After a short post-graduate course in physics and chemistry, he entered practical life again as a draughtsman for the Brooklyn Elevated R. R., at the same time teaching Mathematics at the Workingmen's Lyceum, and during the next two years enlarged his experience by holding positions as draughtsman for Wilson Bros. & Co., Wm. Sellers & Co. and I. P. Morris & Co., being especially called to the latter place to assist in the designing of Mr. E. D. Levitt's 5,200 H. P. hoisting engine for the Calumet & Heckla Mines.

In 1880 when the great discoveries of silver at Leadville, Colorado, attracted general attention, Mr. Falkenau was persuaded to go to this mining camp, and he there opened an engineering office, and became consulting engineer for a number of mining and smelting companies. An extensive fire in the Chrysolite Mines, led him to invent a mine exploring apparatus, which was adopted by the Chrysolite Company, and which attracted considerable attention at the time. Being urged by the managers of a Mining and Smelting Company to establish a shop, he built a foundry and machine works, which soon became the largest in that region. He is still the proprietor of these, but overwork at this high altitude brought on illness, which necessitated his permanent return to the East. For two years he was assistant engineer at the Dickson Manufacturing Co., of Scranton, Pa., during which time he made an extended trip through Mexico. The results he obtained on his trip he presented in a paper, read before the Engineers' Club, of Philadelphia, March 19, 1892, entitled, "The Cost of Power in Mexico and Other Western Mining Regions." In 1888 Mr. Falkenau established a machine shop at Eleventh and Ridge avs., Philadelphia. This is equipped with the most modern machine tools and intended for the construction of special machinery of all kinds. During the last year he built all of the machinery and conduits for the First U. S. Pneumatic Postal System, which attracted considerable attention,

UNDER the above firm name Messrs. Arthur Falkenau, M. E., Edwin R. Keller, B. S., M. E., Clayton W. Pike, B. S., and Elmer G. Willyoung, B. S., have formed a co-partnership for the purpose of conducting a general business as mechanical and electrical engineers, with offices in the Betz Building, Philadelphia.

The company will devote itself to designing and building light, heat, ventilating and power plants, central stations and electric railways, complete or in part, and to giving expert advice in all matters pertaining to the same. Special attention will also be paid to making expert examinations and tests of existing plants with a view to increasing their capacity or economy of working.



ELMER G. WILLYOUNG.

especially since some of the largest shops in the country had declared that the work could not be done in the time allowed for its completion. Among the specialties turned out, in Mr. Falkenau's shop, the universal and cutter grinders, tool grinders, hydraulic valves, flanging machines and belt pumps are well known; a number of dynamite projectiles for pneumatic guns have also been built in this shop. While in Leadville Mr. Falkenau established a Workingmen's Lyceum, and contributed to the columns of several well-known technical journals. He is a member of the American Society of Mechanical Engineers, and of the Engineers' Club, of Philadelphia, of which he is vice-president, and one of the most active contributors. He is also a member of the Manufacturers' Club, of Philadelphia.

MR. ELMER C. WILLYOUNG was born in 1865, at Buffalo, N. Y., in which city he passed his earlier years. When he was about twelve years of age, Mr. Willyoung's family removed to Detroit, Mich., where he obtained his collegiate preparation at the Detroit High School, entering the University of Michigan at Ann Arbor, in the Spring of 1885 as a candidate for the Civil Engineering Degree. Soon finding, however, his likings to be more in the direction of mathematics and general scientific studies, he changed over from the Civil Engineering to the General Science course. In the Summer of 1886, Prof. H. B. Carhart, being called from the Northwestern University to the Chair of Physics at Ann Arbor, Mr. Willyoung was recommended as Assistant by Prof. Mark W. Harrington, now Chief of the United States Weather Bureau, under whose tutelage he had already been working, and was promptly appointed by the Board of Regents. This position Mr. Willyoung held until his graduation, having during this time, general charge of the Laboratory and the experimental demonstration, besides giving a large part of the general Laboratory instruction. For the last year and a half of his course, little else was taken up but practical electrical work, and the study of mathematical electricity.

Besides taking the regular courses, Mr. Willyoung was actively engaged during this period in assisting Prof. Carhart with the numerous pieces of special work, one of which finally resulted in the production of the Carhart-Clark cell. In addition to his work in physics and mathematics Mr. Willyoung took a large number of general engineering courses.

Graduating from the University of Michigan in 1888, with the degree of B. S., Mr. Willyoung was immediately engaged by Queen & Co., the well known instrument makers, at that time desirous of building up an electrical instrument manufacturing business. The first year of his connection with them was spent

in visiting the various colleges and universities throughout the United States, to study their needs. In 1889, the various institutions having been pretty generally visited, Mr. Willyoung located himself permanently at the Chestnut Street store of Queen & Company, at Philadelphia, and immediately undertook the production of a complete line of electrical instruments for both school and college work, all such being, at that time, with few exceptions, made abroad and imported into the United States. The results are well known. Working at first slowly and carefully, and keeping in close touch with scientific and commercial works, one instrument after another was successively brought out under the direction of Mr. Willyoung, each embodying the



C. W. PIKE.

good features of English and Continental construction, and adapted as well to the peculiar conditions of American practice. Those who saw the elaborate display of Instruments at the World's Fair last summer, realized for the first time what stupendous strides instrument making had taken in this country, and were amazed at its scope.

Mr. Willyoung is well-known in the Patent Office, having taken out numerous patents on electrical measuring instruments. One of the best pieces of work which Mr. Willyoung has done is, perhaps, that in connection with exact resistance measurements, to which he has paid special attention, and he is justly regarded as one of the leading experts in the



E. R. KELLER.

country in this line. The study of the "hot wire" principle as a working idea to commercial ammeters and voltmeters has also occupied considerable of Mr. Willyoung's attention. By dint of hard and painstaking work, a complete line of voltmeters was developed by him, embracing portable and commercial forms of all ranges and types, and known as the "Acme" voltmeters.

During his leisure moments, Mr. Willyoung has done considerable writing upon various subjects connected with the methods and apparatus for exact measurements, and his name is familiar to most of our readers in this connection. He now has a two-volume book on the subject of "Electrical Instruments Measurements" in the press of D. Van Nostrand & Co.

Mr. Willyoung has been, for several years past, an active member of the American Institute of Electrical Engineers and will be remembered as the Chairman of the Philadelphia Committee, which provided so handsomely for the comfort and entertainment of the members at the last general meeting in Philadelphia. He is also prominent in the Franklin Institute and the Engineers' Club of Philadelphia, being President of the Electrical Section of the former body, to which office he has been twice elected, as also member of the committee on Science and Arts and of the Library Committee.

MR. CLAYTON W. PIKE was born in Freyeburg, Me., in 1866. After graduating from the Freyeburg Academy he entered the Freshman Class at the Massachusetts Institute of Technology, choosing the course in Electrical Engineering, and was graduated in June, 1889, having presented to the faculty of the Department of Electrical Engineering a thesis embodying the results of an experimental study of the Thomson-Houston incandescent machine. During the summer of the same year Mr. Pike was engaged in perfecting an electrical igniter for the Brayton petroleum engine, and in the autumn he assumed complete charge of the Electrical Department of the Merrimack Manufacturing Co., at Lowell, Mass., the largest cotton manufacturing plant in Lowell, and one which employs a wide variety of electrical appliances. Besides the electric arc and incandescent light and the power work, the plant includes a complete telephone system, watchman's clock, fire alarm, electroplating plant and an enormous battery of primary cells operating the time service for all the mills in Lowell. During his stay the plant was remodeled and its capacity increased about one-third.

In the fall of 1890 Mr. Pike accepted a call to take charge of the instruction in Electrical Engineering at the University of Pennsylvania. He remained there two years, and during this time was a prominent member of the Franklin Institute, acting on the library committee and on the Electrical Sub-committee of Science and Arts. In 1891 he visited the Frankfort Electrical Exposition for the purpose of studying foreign apparatus.

In the summer of 1892 Mr. Pike was offered professorships in Electrical Engineering in two of the Western universities, but feeling that he was not yet ready to decide to make teaching his life work, he entered the employ of Queen & Co., Philadelphia, in their electrical department. It was decided early in the year to make extensive exhibits at the World's Fair and Mr. Pike was selected to take charge of all of these, seven in number. To those who visited the exposition it is needless to say that he succeeded in making those exhibits a credit to the firm and, what is somewhat unusual, a financial success.

Since his connection with the University of Pennsylvania Mr. Pike has been called upon to act as consulting engineer and has written a number of articles on electrical subjects. Mr. Pike is a member of the American Institute of Electrical Engineers, and the Franklin Institute, of the Electrical Section of which he is also Vice President.

MR. EDWIN R. KELLER, the youngest son of Dr. William Keller, of Philadelphia, was born in Darmstadt, Germany, in 1869. In 1884 he entered the University of Pennsylvania, choosing the course in Mechanical Engineering. He received the degree of B. S. in 1888 and that of M. E. in 1889, upon the presentation of a thesis, the result of an experimental and mathematical study of the Otto gas engine. This work, carried on in conjunction with Edgar Kidwell, now Professor of Mechanical Engineering at the Michigan Mining School, was deemed of sufficient value by the college authorities to warrant publication in the *Journal of the Franklin Institute*.

Mr. Keller was for two years engaged as Instructor in Mechanical Engineering in the University of Pennsylvania and spent one year in Hanover, Germany, as a student at the "Technische Hochschule," studying Electrical Engineering under Prof. W. Kohlrausch and devoting some time also to the higher mathematics. He has also been engaged in practical engineering and machinist's work at Roach's Shipyard, the Cambria Iron Co. and Wm. Wharton, Jr. & Co. In the Spring of 1893 he went to Chicago to represent "Industries and Iron" (London), to which he had for several years been a contributor, at the World's Fair.

Mr. Keller has also done some literary work, and is a member of the American Institute of Electrical Engineers and of the Engineers' Club of Philadelphia.

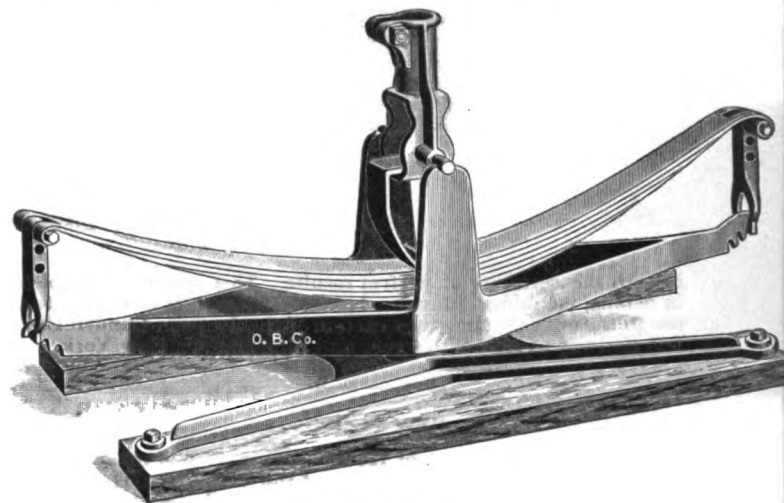
THE OLD-TIME TELEGRAPHERS and the U. S. Military Telegraph Corps are to have their annual meeting, at Baltimore, on Sept. 12.

RECENT SALES OF ACME FILTERS.

THE ACME FILTER CO., 620 N. Main street, St. Louis, Mo., report the following list of recent sales of the Acme oil filter: Tallassee (Ala.) Falls Mfg. Co.; Chas. Perkes, Philadelphia; Tombigbee Cotton Mills, Columbus, Miss.; Marble City Electric Co., Rutland, Vt.; Turner Real Estate Co., St. Louis & Suburban Ry. Co., and N. O. Nelson Mfg. Co., St. Louis, Mo.; Bluff City Cotton Mills, and Bohlen, Huse Machine & Lake Ice Co., Memphis, Tenn.; Buffalo, Bellevue & Lancaster Ry. Co., Bellevue, N. Y.; Southern Cotton Oil Co., Houston, Tex.; John Craig, Covington, Tenn.; Diamond Plate Glass Co., Kokoma, Ind.; Standard Oil Co., Cincinnati, O.; New Haven Copper Co., Seymour, Conn.; Vacuum Oil Co., Rochester, N. Y.; Taylor, Dee & Mack, Columbus Dry Goods Co., and Willoughby, Hill & Co., Chicago, Ill.; Rockdale (Tex.) Improvement Co.; Morelton Inn Co., Torresdale, Pa.; Hercules Ice Co., Lexington, Ky.; Jonas Long's Sons, Wilkesbarre, Pa.; Virginia Hot Springs Co., Hot Springs, Va.

THE OHIO TROLLEY.

THE OHIO TROLLEY, manufactured by the Ohio Brass Co., of Mansfield, seems to be one of the simplest and most effective on the market. It is made up of less than a dozen pieces, any of which can be easily duplicated. The spring is of the regular flat leaf style, such as any manufacturer of carriage springs keeps in stock. The working parts of the trolley are made of steel and malleable and wrought iron, and in consequence are not easily broken. The base and stand are three feet long, and eight inches wide, and, when the trolley-pole is in a horizontal position, but thirteen inches high. The trolley-pole can be swung either for-



THE OHIO TROLLEY.

ward or backward or in a complete circle, and the pressure against the trolley wire diminishes as the pole assumes more nearly a horizontal position.

The trolley can be assembled or dismantled in a few minutes' time without the aid of tools. It is very easy and flexible in action, and will follow the variation of the trolley wire quickly and surely. These trolleys have been given a practical and thorough test, and are in use on many roads.

In fitting these trolleys out complete, the Ohio Brass Co. use their special carbonized steel trolley-pole. This pole is drawn cold through a die and is made of the best Norway iron. It is then carbonized to the proper degree to give it sufficient elasticity. It is seamless and endless, and formed to a perfect taper. The claim made on this pole is that it is lighter, more flexible and stronger than the regular style trolley-pole. It will not break, and if bent out of shape can be straightened cold without injury.

This pole is one of the specialties of the Ohio Brass Co. which they are now pushing into the market.

TEST OF LUNDELL FAN MOTORS.

Messrs. D. C. Durland and S. Townsend have made a series of tests of the Lundell fan motors, made by the Interior Conduit and Insulation Co., of 44 Broad street, New York City. Three sizes were tested and twelve motors of each size were taken at random from stock. The mean results were as follows:

No. 560, running at 1782 revolutions per minute, consumed .44½ ampere at 114.96 volts; No. 562, at 1,423 revolutions, .84½ ampere at 114.7 volts, and No. 568, at 116.16 revolutions, took 1.0 ampere at 114.89 volts.

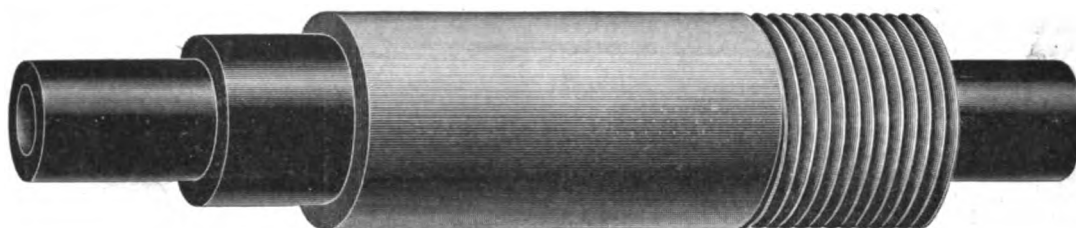
The tests were made at the factory of the company.

NEW CENTRAL STATION FOR BRADFORD, PA.

The Berlin Iron Bridge Co. have received the contract for a new electric light and power station for The Bradford Electric Light & Power Co., at Bradford, Penn. The building is 65 ft. wide and 160 ft. long, with brick side walls, the roof being of iron covered with Berlin patent anti-condensation corrugated iron roof covering. When completed, this will be one of the finest and most complete stations in western Pennsylvania, and also so constructed as to be absolutely fire-proof, there being no woodwork about the building to take fire.

TELESCOPIC IRON ARMORED INSULATING CONDUIT FOR UNDERGROUND WORK.

THE telescopic insulating conduit with an iron armor, shown in the accompanying illustration, is the latest addition to the underground conduit system of the Interior Conduit and Insulation Company. The telescopic arrangement, whereby lengths of plain insulating conduit are slipped into lengths of the iron armored insulating conduit so that the sections break in the centres of the lengths, gives a double insulation, and at the same time an iron armor for protection. The lengths are coupled together by straight threading the ends, and abutting them in the centre of the coupling, thus producing an underground conduit that is thoroughly waterproof, lasting and possessing the highest insulating qualities, so high in fact that bare wires can be drawn



TELESCOPIC IRON ARMORED INSULATING CONDUIT FOR UNDERGROUND WORK.

in with the certainty of perfect results. This system is complete in details, including junction boxes, etc., and is now in actual use in the underground construction of the Johnson-Lundell Electric Railway at East 69th street and First avenue, New York.

NEW YORK NOTES.

MR. S. W. RUSHMORE, of 126 Liberty street, has made for the Southern Pacific Steamship Co. six of the well-known Huntington search lights that he is manufacturing for the Scott Electrical Mfg. Co.

MESSERS. FORD & BACON, consulting engineers of Philadelphia, have opened an office in the Mail & Express Building, No. 308 Broadway, New York. This firm make a specialty of electric railway, power transmission and lighting plants.

MR. WILLIAM A. CAREY has severed his connection with the General Electric Company and is now managing the railway and lighting plants, owned or controlled by the United Electric Securities Co., with offices in the Ames Building, Boston.

THE IMPERIAL ELECTRIC LAMP COMPANY, of the Postal Telegraph Building, 249 Broadway, manufacturers of arc lamps for incandescent circuits, have issued a folder giving an illustration of their lamps in the office of the Barrett House, at Broadway and Forty-third street. It is claimed for these lamps that they are the shortest and lightest in the market. They are furnished in japan, polished brass, dull brass, old brass, wrought iron, gilt, etc., with shades of crystal, opal or alabaster, of any quality and design.

WADDELL-ENTZ APPARATUS.—Clients and friends of the well-known Waddell-Entz apparatus will be glad to learn that arrangements have been perfected by which the manufacture of the Waddell-Entz dynamos and motors will be carried on with improved manufacturing facilities and on a more extensive scale than formerly. The machines will be built in Bridgeport, Conn., in a new shop fully equipped with the most improved tools and machinery, overhead travelling crane, etc., and the most ample facilities for turning out the highest class of mechanical work with promptness and despatch. Mr. Waddell still retains his connection with the enterprise, and the Sales Department will be in charge of Mr. J. A. Machado, who has been connected with the Waddell-Entz Company since its organization. Correspondence and inquiries should be addressed to J. A. Machado, Agent, 203 Broadway, Mail and Express Building, New York City.

MESSERS. J. H. BUNNELL & Co., of 76 Cortlandt street, New York City, have issued "Telephone Circular No. 4," describing their improved standard telephones with metal cased transmitters, and giving directions for setting up and using the instruments. They are now prepared to furnish practical, non-infringing telephones for lines up to fifteen miles in length.

NEW ENGLAND NOTES.

THE COLUMBIA ELECTRIC CO., Burnside Building, Worcester, Mass., have just been awarded the contract for the electrical work on the Westboro Insane Hospital, Westboro, Mass. It will require between 800 and 1,000 lights, with dynamos, wiring, etc.

THE "NATIONAL" TELEPHONE MANUFACTURING COMPANY of Boston, has just received an order for 1,000 receiver and transmitter telephones for use in the new Hotel "Majestic," New York City. This order speaks well for the efficiency of the "National" telephone.

THE MATHER ELECTRIC COMPANY, of Manchester, Conn., report signs of marked improvement in the electrical business, they now having on hand more work than at any other time for the last eighteen months. The recent sales of their standard belted, and also of their new direct connected apparatus, for lighting work, have been very large, necessitating a large addition to their working force in their works at Manchester. The Mather Electric Company also report a very good business throughout the West-

ern and Central States, in which territory they are very well represented by their Western contractor, J. Holt Gates, of 1140 Monadnock Building, Chicago.

WESTERN NOTES.

MR. CHARLES A. BROWN of Barton & Brown, Chicago, has returned from an Eastern trip of several weeks' duration.

MR. B. J. ARNOLD, consulting electrical engineer, has removed his office from room 436, the Rookery, Chicago, to rooms 574-576, the same building.

THE MASON ELECTRIC CO., Chicago, are getting gradually in shape at their new store, No. 7 Adams street. Mr. Mason reports an increasing demand for the Medberry overhead line material.

THE EUREKA ELECTRIC REPAIRING AND CONSTRUCTION CO. is the style of a new firm recently established in Chicago and consists of Messrs. S. L. Knode, W. P. Rutherford and E. Horne, all three gentlemen having had a varied experience in all branches of the business.

THE following companies have recently been incorporated: CENTRAL BELL TELEPHONE COMPANY of Venezuela, Chicago; capital stock, \$400,000; incorporators, Jacob K. Meyers, Frank A. Amerman and Timothy J. Fell.

THE CITIZENS ELECTRIC COMPANY, Springfield; capital stock, \$60,000; incorporators, John McCreery, Fred A. Buck, L. H. Coleman, P. W. Harts and Edwin A. Wilson.

THE NEW ATHENS ELECTRIC LIGHT AND POWER COMPANY, New Athens, Ill., with a capital of \$4,500; incorporators, I. Probst, Paul Lehman and Frank Feuerbacher.

UNITED TELEGRAPH, TELEPHONE AND ELECTRIC COMPANY, at Chicago; capital stock, \$1,000,000; incorporators, Donald McDonald, John G. Earle and Edward P. McConnell.

MATTOON TELEPHONE COMPANY, at Mattoon; capital stock, \$10,000; incorporators, James H. Clark, George N. Buck, I. A. Lumkin, John W. Gay, Louis Katz, J. A. Hamilton and J. N. Henley.

Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE Electrical Engineer.

Vol. XVIII.

AUGUST 22, 1894.

No. 329.

MAGNETIC LEAKAGE IN DYNAMO-ELECTRIC MACHINERY.—I.

BY

Alfred E. Wiener.

IN the following the writer has developed some novel methods of calculating the magnetic leakage in dynamo electric machines, and, in order to cover the subject systematically, has treated the same under the following headings, which, for the convenience of the reader, are here given :

Introduction : Useful and Total Magnetic Flux in Dynamo.

I. CALCULATION OF LEAKAGE FACTOR FROM DIMENSIONS OF MACHINE.

- A. *Formula for Probable Leakage Factor.*
 - a. Smooth Armature.
 - b. Toothed and Perforated Armature.
- B. *General Formulae for Relative Permeances.*
 - a. Two plain surfaces inclined to each other.
 - b. Two parallel plane surfaces facing each other.
 - c. Two equal rectangular surfaces lying in one plane.
 - d. Two equal rectangles at right angles to each other.
 - e. Two parallel cylinders.
 - f. Two parallel cylinder-halves.
- C. *Relative Permeances in Dynamo Electric Machines.*
 - a. General Principle.
 - b. Relative Permeance of Air Gaps.
 - c. Relative Average Permeance across Magnet Cores.
 - d. Relative Permeance across Pole Pieces.
 - e. Relative Permeance between Pole Pieces and Yoke.
- D. *Comparison of Various Types of Dynamos.*
 1. Upright Horseshoe Type.
 2. Inverted Horseshoe Type.
 3. Horizontal Horseshoe Type.
 4. Single Magnet Type.
 5. Vertical Double Magnet Type.
 6. Vertical Double Horseshoe Type.
 7. Horizontal Double Horseshoe Type.
 8. Horizontal Double Magnet Type.
 9. Bipolar Iron Clad Type.
 10. Fourpolar Iron Clad Type.

II. CALCULATION OF LEAKAGE FACTOR FROM MACHINE TEST.

- A. *Magneto-Motive Forces.*
 - a. General Formula for Computing the Magneto-Motive Force for any Part of a Magnetic Circuit.
 - b. Ampere Turns for Air Gaps.
 - c. Ampere Turns for Armature Core.
 - d. Ampere Turns for Compensating Armature-Reactions.
- B. *Calculation of Total Flux in Dynamo.*
 - a. Calculation of Total Flux if Magnet frame consists of but one Material.
 - b. Calculation of Total Flux if Magnet frame consists of two different Materials.
- C. *Actual Leakage Factor of Machine.*

III. EXAMPLES.

1. Inverted Horseshoe Type.
2. Upright Horseshoe Type.

3. Single Magnet Type.
4. Double Magnet Type.
5. Double Horseshoe Type.
6. Bipolar Iron Clad Type.
7. Radial Multipolar Type, with Toothed Armature.
8. Radial Multipolar Type, with Smooth Armature.
9. Innerpole Type.
10. Axial Multipolar Type.

INTRODUCTION.

The useful flux, Φ , of a dynamo being given, the amount of the magnetic leakage, λ , determines directly the total flux, Φ , of lines of force through the magnet frame.

By a well-known formula, the useful flux in any dynamo is

$$\Phi = \frac{6 \times p' \times E \times 10^9}{K \times N}, \dots \dots \dots (1)$$

where Φ =useful flux, in lines of force, or in webers ;
 E =total E.M.F. to be generated in armature, in volts;
 p' =number of pairs of armature portions electrically connected in parallel (usually equal to the number of pairs of magnet poles);
 K =number of conductors all around pole-facing circumference of armature ;
 K =number of convolutions for ring armatures;
 K =half the number of convolutions for drum-wound armatures ;
 N =speed, in revolutions per minute ;

For bipolar machines, and for multipolar dynamos with series connections, the number of pairs of parallel armature circuits is $p'=1$, and for this special case we consequently have,

$$\Phi = \frac{6 \times E \times 10^9}{K \times N}, \dots \dots \dots (2)$$

and this is the formula which is usually given.

From (1) the total magnetic flux, which is needed for the determination of the sectional areas of the various portions of the magnetic circuit in the frame, and for the calculation of the magnetomotive-force, is found by simply multiplying the useful flux by the factor of leakage:

$$\Phi' = \lambda \times \Phi = \lambda \times \frac{6 \times p' \times E \times 10^9}{K \times N} \dots \dots (3)$$

The leakage coefficient, consequently, has a direct influence upon the dimensions of the machine to be designed, and since, furthermore, the magnetomotive force required depends upon the magnetic flux to be effected, λ has a bearing also upon the magnet winding.

In calculating a dynamo electric machine, therefore, it is essential to predetermine, with sufficient accuracy, the value of the magnetic leakage. And that such a calculation of the probable leakage factor is necessary in every single case is evident from the fact that not only the leakage in two machines of the same general design and even of approximately the same size, which are merely differently proportioned in their essential parts, may differ widely from each other, but that in one and the same dynamo the amount of the leakage can be considerably varied by using armatures of different core diameters in its field.

For the same reason it may also be concluded that the

method of assuming a value of λ from previous experience with a certain type, or even with an individual machine, is an entirely unreliable one, and that calculations based upon such an assumption cannot be depended upon.

I. CALCULATION OF LEAKAGE FACTOR FROM DIMENSIONS OF MACHINE.

The predetermination of the magnetic leakage, within the limits of practical accuracy, for a machine in the process of calculation is by no means such a difficult operation as might be inferred by consulting the respective chapters in text-books on dynamo-electric machines. In Silvanus P. Thompson's "Dynamo-Electric Machinery,"¹ for instance, a set of logarithmic formulæ (Forbes') are given for the computation of the magnetic leakage, and in his "Lectures on the Electro Magnet,"² a formula, called by himself "rather complex" is contained, all of which seem to be designed rather to scare off the practical electrician from entering into that field than to induce him to figure his leakage.

For the leakage resistance of upright and inverted horseshoe types, Kapp³ has given two very simple empirical formulæ, which, however, have not much practical value, as they merely have reference to the size of the machine and are independent of the dimensions and the design of the field-frame, and will therefore give correct results only in case of dynamos having exactly the same relative proportions as those experimented upon by Kapp.

The writer, who has undertaken to cover the entire field of dynamo calculation by simple and practical formulæ,⁴ has succeeded in also bringing the leakage calculation within that scope, and herewith gives his formulæ, which—as will be shown hereafter—enable the calculation of the probable leakage factor of a dynamo to be made from the dimensions of the machine, by a very simple process and to within but a few per cent. of the actual value.

A. Formula for Probable Leakage Factor.

Since air is a conductor of magnetism, the conditions of the magnetic circuit of a dynamo-electric machine resemble those of a closed metallic electric circuit immersed in a fluid. In the latter case, the main current will flow through the metallic conductors, but a portion will pass through the fluid. Similarly for the magnetic circuit, the main path for the magnetic flux being the magnetic circuit of the dynamo, consisting of the iron field-frame, the air gaps and the armature-body. The amount of electric current passing through the surrounding medium, the fluid, depends upon the ratio between the conductances of the main to the shunt paths. In order to calculate the amount of magnetic leakage in a dynamo, therefore, it is, analogically, only necessary to determine the ratio between the permeances of the useful and the stray paths.

(a). Smooth Armature.

The leakage factor in any dynamo having a smooth armature can accordingly be expressed as the quotient of the total joint permeance of the system by the permeance of the useful path. But since the reluctance of the iron portion of the main path is very small compared with that of the air-gaps, the sum of their reciprocals, that is, the total permeance of the useful path, is practically equal to the permeance of the gaps; hence the permeance of the gaps can be taken as a substitute of the permeance of the whole magnetic circuit within the machine, and we obtain the following formula for the probable leakage factor of any dynamo having a *smooth* armature:

$$\lambda = \frac{\text{Joint permeance of useful and stray paths.}}{\text{Permeance of useful path.}}$$

or,

$$\lambda = \frac{P_1 + P_2 + P_3 + P_4}{P_1}, \dots\dots\dots (4)$$

where P_1 = relative permeance of the air-gaps (useful path);

P_2 = relative average permeance across magnet-cores (stray path);

P_3 = relative permeance across polepieces (stray path);

P_4 = relative permeance between polepieces and yoke (stray path).

The "relative" permeances—by which are understood the absolute permeances divided by the magnetic potential, and which, therefore, include a constant factor, on account of the units chosen—are taken for convenience, for in each individual case the maximum magnetic potential is the same for all permeances, and a constant numerical factor, if absolute permeances were used, would be common to all terms in (4), and consequently would cancel.

(b). Toothed and Perforated Armature.

In toothed and perforated armatures a portion of the magnetic lines of the main path enters the iron projections of the core and passes through the armature without cutting the conductors. This portion, therefore, can not be considered as useful, and has to be taken into account in computing the total leakage coefficient of the machine. Introducing this leakage into the calculation in the form of a factor, the "*factor of armature leakage*," we obtain the probable leakage factor of any dynamo having a *toothed* or *perforated* armature:

$$\lambda' = \lambda_1 \times \lambda = \lambda_1 \times \frac{P_1 + P_2 + P_3 + P_4}{P_1} \dots\dots (5)$$

The factor, λ_1 , of this core-leakage, that is, the ratio of the total flux of the useful path passing the air-gaps, to the actual useful flux cutting the armature conductors, or to the total flux through the gaps minus that portion leaking through the teeth, depends upon the relative sizes of the slots to the teeth, and for armatures otherwise properly dimensioned, has been found to average within the following limits:

Table I. Core Leakage in Toothed and Perforated Armatures.

RATIO OF WIDTH OF SLOTS TO THEIR PITCH ON OUTER CIRCUMFERENCE	FACTOR OF ARMATURE LEAKAGE.		
	TOOTHED ARMATURES		PERFORATED ARMATURES
	STRAIGHT TEETH	PROJECTING TEETH	
0.4	1.40 to 1.85	1.55 to 1.50	.....
.45	1.85 " 1.30	1.50 " 1.45	.....
.5	1.30 " 1.25	1.45 " 1.40	1.50 to 1.45
.55	1.25 " 1.20	1.40 " 1.35	1.45 " 1.40
.6	1.20 " 1.15	1.35 " 1.30	1.40 " 1.35
.65	.....	.....	1.35 " 1.30
.7	.....	.....	1.30 " 1.25

FRENCH ATLANTIC CABLE PROJECT.

In a brochure lately published by M. P. Bordonnaut, a direct cable between France and her West Indian possessions is advocated. M. Bordonnaut (late chief engineer of French Government telegraphs) gives estimates of the cost of this work, and is satisfied that a considerable reduction may be effected on the present rate for telegrams to the West Indies. From the French point of view such a cable will be useful, not only as furnishing direct communication with the West Indian Islands, but also as assisting the French company, which already has a network of cables amongst these islands, extending as far south as Brazil.

1. S. P. Thompson, "Dynamo Electric Machinery," 4th Ed., p. 186.
 2. S. P. Thompson, "Lectures on the Electro Magnet," authorized American edition, p. 147.
 3. Gilbert Kapp, "Electric Transmission of Energy," 3d Ed., p. 122.
 4. A. E. Wiener, "Practical Notes on Dynamo-Calculations," *Electrical World*, Vols. xxiii. and xxiv., 1894.

THE RESONANCE OF ELECTRICAL CIRCUITS.

BY

Wm. A. Anthony.

IN THE ELECTRICAL ENGINEER for August 8 I find an article by Mr. F. W. Dunbar upon the "Resonance of Electrical Circuits," in which he takes exception to some conclusions which he thinks he has found in my recent articles in the ENGINEER upon the same subject. He devotes considerable space in this article to the demonstration of the fact that the current at the antinodes of a resonant circuit is greater than would be maintained by the same E. M. F. on a non-resonant non-inductive circuit of the same resistance, a fact that I never for a moment doubted, and which it was farthest from my intention to deny. My file of the ENGINEER is packed up and somewhere on the road, so I cannot, at this moment, refer to my articles; but in referring to the current in the circuit as equal to $\frac{E}{R}$, I meant what might be called the average

current upon the whole circuit, and it was only another way of saying that the current in a perfectly resonant circuit is limited only by the resistance of the line.

Indeed, I am sure I called attention to the fact that since, on a resonant circuit containing distributed inductance and capacity, there are nodes of no current, the $I^2 R$ loss, when the current at different points of the circuit is represented by a sine curve, is only half as great as when a current equal to that at the antinodes exists all along the circuit. From this it follows at once that only half the E. M. F. is necessary to maintain the current on a resonant circuit as upon one of the same resistance but devoid of self induction.

I may say here that in my article upon this subject, I had in view the transmission of power for lighting or motors, and although I know that it is perfectly possible, theoretically, to adjust a receiving apparatus to unison with the vibrations of the line, yet such an adjustment is an exceedingly delicate one, and I have yet to see any method by which an electric motor, for instance, can be adjusted to maintain its unison with the line under all the varying demands that may be made upon it and maintain a high efficiency under the varying loads. But admitting that all this can be done, we have still the great electric stress at the current nodes which Mr. Dunbar tries to show is not a serious matter.

In relation to this I wish to point out that the saving in transmission upon a resonant circuit is due to the fact that there are upon the circuit nodes of no, or comparatively little, current. The energy lost is reduced to half that upon a circuit when the current is the same throughout, only when the current at the nodes is zero. But the current at the node cannot be zero if energy is transmitted through it in one direction in excess of that in the other. Hence in a system for transmission of energy not quite half the loss can be avoided by using a resonant circuit.

Mr. Dunbar states that for a resonance circuit Ln need not be more than $2.5 R$ and that in this case the stress at the node will only be ten times that at the generator and receiver.

But this value of Ln applies only to the case where the energy supplied is (after the full current has been established) all absorbed by the resistance of the circuit.

It is entirely otherwise when useful work is performed at the distant end. The necessary value of L is then determined not by the resistance of the line, but by the power which is to be delivered. In Mr. Dunbar's Fig. 11, although a cord of small mass might vibrate freely if it were only impeded by the resistance of the air, it would

require a cord of large mass to impart any considerable energy to the wheel. In short, the mass of the cord in the figure referred to must be such that it may, by reason of its inertia, supply the force necessary to operate the wheel without losing any considerable portion of its own motion. In other words, the energy given to the receiver and received from the generator during each vibration must be but a small fraction of the energy stored in the circuit if its condition as a resonant circuit is to be maintained.

I do not know that I understand Mr. Dunbar's statement that a large portion of the energy of a piano string is conveyed to the sounding board. No doubt it is *in time*, but a piano string will vibrate for some seconds, or will execute many hundreds of vibrations before coming to rest, which means that it imparts to the sounding board during one vibration not a hundredth part of the energy stored in it. But suppose it possible to maintain the resonant vibration on the circuit and give up to the receiver during each period one-fifth of the energy stored upon the circuit. This would mean that, when that energy is stored in the form of electro-static stress at the nodes, the pressure there is five times as great as the maximum at the receiver; and I insist that even this is no small matter in long-distance transmission of power, for the line insulation limits the pressure it is possible to use, and, on a resonant circuit, this limiting pressure must be taken as the pressure at the nodes, which means that on the rest of the circuit the pressure is much less than might be employed.

Referring again to Mr. Dunbar's Fig. 11, here reproduced, he states that the velocity of vibration of the rope will diminish as the energy absorbed by the wheel increases. So it will be; but suppose the efficiency of the line is to be 75 per cent. To obtain this the current must be reduced to at most one-fourth. The stored energy is reduced to one sixteenth, and, if the stored energy, when the resistance only was to be overcome, was ten times that absorbed and dissipated at each vibration, it will now be only 2.5 times as great; and, if it were possible to ascertain

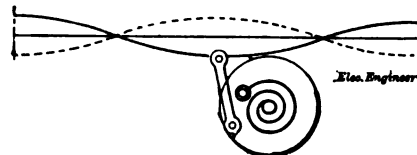


FIG. 11. (DUNBAR.)

the vibration at all, the current at the nodes would be so large in relation to that at the antinodes that the advantage of the resonant circuit in reducing the loss of energy on the line would be in great measure destroyed.

In saying that the pressure at the nodes might be hundreds or thousands of times that at the generator, I no doubt overstated the necessary relation for a circuit designed expressly for resonant transmission, but knowing the delicacy of adjustment required to secure resonance and the slight disturbance required to destroy it, I am convinced that, when the resistance to be overcome is the counter-electromotive force of a motor under varying load, the energy given to the motor during each period cannot be a tenth or even a fiftieth of that stored upon the circuit without danger of destroying the adjustment. But the pressure at the nodes bears to the pressure at the motor the same ratio as the energy stored bears to the energy delivered during each period.

It is quite possible that resonant transmission might find a useful application on some telegraph lines where vibrations of a definite period can be employed, but I fail to see how it could be applied to telephone lines where greatly varying periods must be transmitted, and I cannot see how resonance can be made use of to any advantage in power transmission where the only limit to the pressure that may be employed is our ability to take care of it on the line.

BALANCING TURBINES MAGNETICALLY.

The difficulties experienced in lubricating the bearings of turbines under heavy heads of water have given rise to many devices for overcoming this trouble. The device most generally employed for this purpose is to balance the turbines. Where the weights to be carried, however, are very large this method is not always efficacious and where the heads of water are small it can-

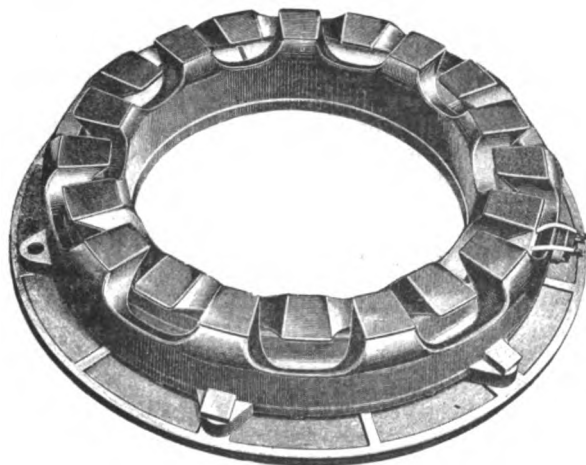


FIG. 1.—MAGNETIC TURBINE BALANCE.

not be applied at all. Besides, as hydraulic balancing requires a turbine designed for this purpose from the very start, it cannot be applied to existing turbines. The balancing of turbines has become a special problem for the electrical engineer since numerous installations, embodying turbines directly connected to dynamos like those at Niagara, have already been put into operation, and many more will be installed in the future.

In view of this situation the Maschinenfabrik Oerlikon, of Switzerland, has designed a magnetic balancing apparatus which relieves the bearing of turbines of the superincumbent weight. The largest apparatus of this kind thus far constructed balances a load of about 80,000 pounds, consisting of a 600 H. P. Oerlikon three-phase dynamo, and a 600 H. P. turbine without hydraulic balancing; this plant is situated at the water works of the Rhone Land and Water Power Company, Ltd., Bellegarde, France.

The balancing apparatus consists, essentially, of a wreath-shaped magnetic field, Fig. 1, similar to that of the Oerlikon alternating machine and wound with a single exciting coil, both of which are suspended in a stationary position above the turbine and dynamo to be balanced. Attached to the shaft is a ring armature, as shown in Fig. 2, built up of ribbon iron. This armature closes the magnetic circuit of the alternating poles of the magnet shown in Fig. 1. The attraction between the poles and the armature, amounting to three kilograms per square centimetre

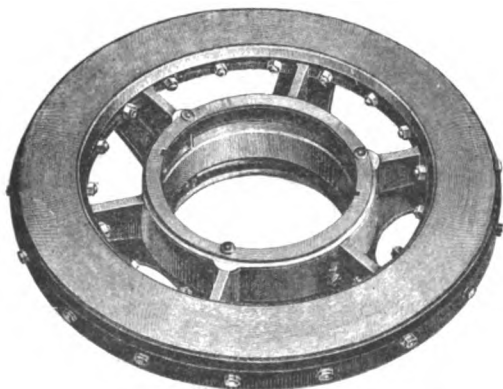


FIG. 2.—MAGNETIC TURBINE BALANCE.

constitutes the balancing force. The space between the magnet poles and the armature is greater than that between the guides and the buckets of the turbine. Provision is also made for varying the attractive force. The power required for operating the magnet is very small, that is, about $\frac{1}{2}$ H. P. per ton of load carried, which is far less than the energy consumed in friction at the bearings with the turbine unbalanced. It is evident that this balancing device is applicable to other machines besides turbines and dynamos, and can be applied whether the force to be balanced is vertical or horizontal.

TEST OF A CLOSED-COIL ARC DYNAMO.¹

BY PROF. R. B. OWENS AND C. A. SKINNER.

THE object of the present paper is to show something of the nature of the armature reactions which occur in arc light machines of the closed-coil type, maintaining constant current by automatically shifting the brushes to correspond with changes in load in the external circuit, and to point out certain alterations in design which it is believed may be adopted with advantage. Incidentally other points will be noted.

It is not intended to discuss the relative advantages of the several types, but only to give some results obtained in a test of a closed-coil machine regulating as above mentioned. Such machines are now taking a prominent part in the arc lighting industry, and their prominence merits for them more close study. The machine on which the following experiments were made is a No. 6, 25-light 2,000 C. P. Wood arc dynamo.

The winding data and other details as furnished by the makers are as follows: The field magnet winding is composed of four coils of No. 10 B. and S. gauge copper wire single cotton covered. The outside diameter when insulated is 0.114 inch. Each coil contains 100 lbs. of wire in 15 layers of 74 turns each. The insulation of the magnet cores, is $\frac{1}{4}$ inch thick, and composed of one layer of enameled cloth, the enamel surface facing the iron, the remainder being composed of pressboard 0.025 inch thick. The magnet heads are wooden washers $\frac{1}{4}$ inch thick, carefully dried and shellaced.

The armature core is composed of No. 10 B. and S. gauge annealed charcoal iron wire. This is wound on a former which is removable, and is composed of 15 layers $6\frac{1}{4}$ in. wide. These wires are held together by interposed strips of linen tape. The core is then insulated with a layer of asbestos paper, 8 thicknesses of pressboard 0.15 in. thick, one layer of asbestos paper again and then over this one more layer of pressboard 0.15 in. thick, making a smooth surface for the copper wires to be wound on. The insulations near the spider arms are built up of the same material and in the same manner as the armature core, until they attain a thickness of $\frac{1}{4}$ in. The armature is wound with 100 sections of No. 14 B. and S. gauge double covered cotton wire. Each section is composed of 93 feet, or 57 turns per section, making a total of 115 pounds of wire. The regulator magnet is wound with No. 11 single cotton covered B. and S. gauge wire, in the manner shown on the dynamo. The insulation of the cores being $\frac{1}{4}$ in. thick, and that of the magnet heads $\frac{1}{4}$ in. Speed of dynamo, 1,000 rev. per minute.

Conditions of Test.—The dynamo was securely bolted to a firm foundation of masonry, and driven through a 7 in. belt by a small 8 in. x 10 in. high-speed automatic Atlas engine making 250 revolutions per minute. Steam was supplied at as nearly constant pressure as possible. The automatic regulator of the dynamo was removed, together with one pair of opposite collecting brushes, and the remaining pair reduced one-half in width parallel to the commutator bars, to allow of easier manipulation of the exploring brushes, their angular width being of course adjusted for each load to prevent sparking.

It was at first attempted to use a number of arc lamps as load for the dynamo, but though carefully adjusted and using cored carbons, the variations of potential and current due to their feeding was greater than could be admitted, so the lamps were discarded for two water rheostats 4 foot x 1 foot x 1 foot, with carbon electrodes. These latter, on the whole, were found to work quite satisfactorily; their resistance when hot was considerably less than when cold, but it changed so gradually that no trouble was experienced in correcting for it by adjusting the electrodes.

The distribution of the induction entering the armature at different loads was obtained by taking the E. M. F. at various points on the commutator between two small pilot brushes moved around and in contact with it.

The two brush method, though somewhat more difficult to work than the single brush method, has the advantage over the latter of giving the quantities sought directly, instead of as a difference between quantities, which are large as compared with those desired. In some cases the integral readings of the brush method have been plotted, but curves so obtained do not indicate so clearly what is mainly sought, namely, the distribution of lines of force entering the armature. True, one curve can be approximately obtained from the other if electrostatic instruments are used, but not with electromagnetic instruments, for they will give only a mean E. M. F., depending on the relative width of a commutator bar and insulation and distance apart of the pilot brushes. The results obtained, however, with a voltmeter of the Weston type are proportional and for the present purpose are equally valuable.

The exploring brushes as finally used were pieces of steel watch springs firmly held in small fibre holders. These, in turn, were rigidly secured by brass studs to a graduated sliding ring, moving within another stationary ring, attached to and insulated

1. Abstract of a paper presented at the Eleventh General Meeting of the American Institute of Electrical Engineers, Philadelphia, May 16, 1894.

from the dynamo frame, and carefully centred with the commutator.

Two brushes were used in each holder to better insure good contact. Copper, brass and phosphor-bronze exploring brushes were tried at first but found not as satisfactory as steel. It was also found very necessary at all times to keep the brushes and commutator as clean as possible.

The sliding ring was marked off into one hundred divisions, the number of commutator segments, and the exploring brushes

rents in the field of 8, 10 and 12 amperes and no current in the armature. The results obtained were compiled in tables and for a current of ten amperes are plotted in corresponding plates.

The reactions of the armature are so clearly shown by the curves that comment hardly seems necessary. Briefly, we see that the total induction in the armature varies very slightly with lead and the displacement of the neutral plane decreases with lead angle but varies less than 10 degrees from no load to the maximum load used.

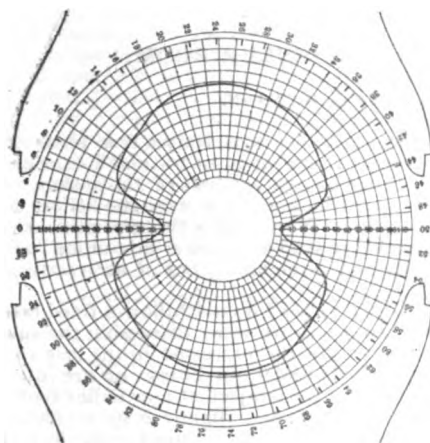


FIG. 1.

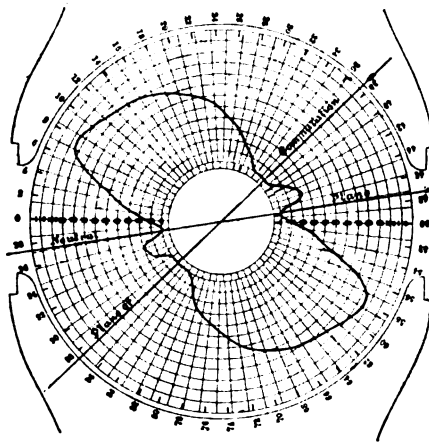


FIG. 2.

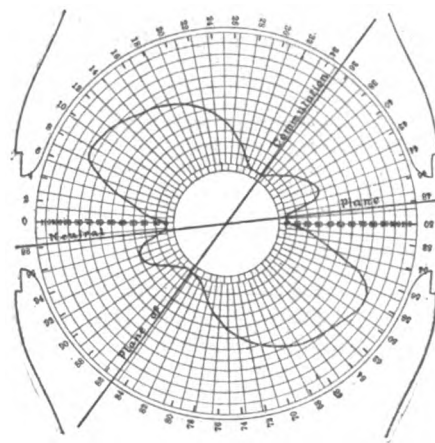


FIG. 3.

made to cover just two commutator bars or one-fiftieth of the circumference, but the ring might have been divided into degrees if desired. The curves shown in Figures 1, 2, 3, 4, 5 and 6 are plotted so that the results may be read either in degrees or in divisions of the graduated ring.

The inner circle representing the commutator of one hundred segments and the 100 divisions of the ring are marked on the outer circle.

The radial lines are 5 degrees apart, and the radial distance between concentric circles represents 10 volts. If the results had been plotted on a developed diagram, then the areas of the curves would have represented total or integral electromotive forces, but the circular diagram has the advantage of appealing more quickly to the eye, and though the total E. M. F. is not exactly represented by the area it is proportional to the number of the small approximate rectangles enclosed. In obtaining efficiency measurements the power delivered to the dynamo was obtained by indicating the engine. The cards were taken with a Tabor indicator and worked up with a Coffin averaging instrument; the speed was obtained by a speed counter and stop watch. The electrical instruments used were a Weston 15 amperemeter for current measurements. A Weston 15 and 150 voltmeter for potentials between pilot

All electromotive forces on one side of the neutral plane are of the same sign but differ in sign from those on the opposite side.

On a developed diagram the electromotive forces between collecting brushes would be proportional to the difference between the whole area of curve on one side of the line of commutation and the area of the curve included in the angle of lead. The lead angle being defined as the angular advance of the collecting brushes from the neutral plane. An inspection of the curve of total E. M. F. with angle of lead given in Fig. 5, shows that the E. M. F. between neutral points remains nearly constant as lead varies, which it is believed would not be the case if contracted polar faces were used instead of the extended ones as shown, for then the shifting of the field could not be so easily effected. Of course a machine of the design tested with extended pole tips requires an automatic widening of the brush with increased load or independent control of sparking but it would seem that the waste field at all loads would be less and its weight efficiency greater or cost for a given output less than if its pole tips were cut away. Cutting away the pole tips, or at least not extending them, would have the advantage of allowing the use of collecting brushes of constant width within a certain range but whether this

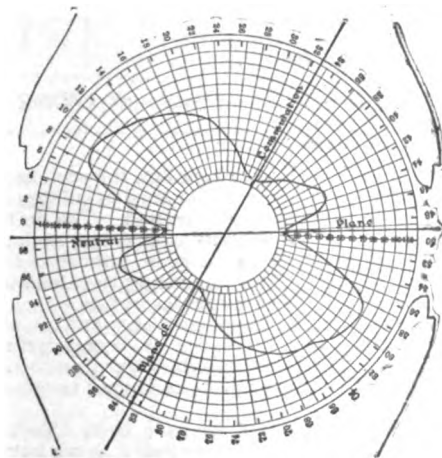


FIG. 4.

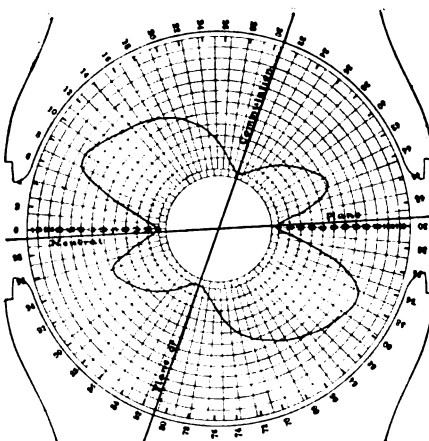


FIG. 5.

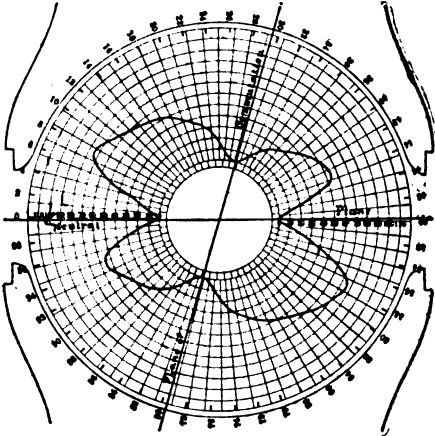


FIG. 6.

brushes and a 150 and 1500 Weston voltmeter for total electromotive forces. All instruments were previously calibrated.

Results Obtained.—Fifteen sets of readings, fifty readings per set, were taken around the commutator with currents in armature and field of 8, 10 and 12 amperes, at positions of the collecting brushes approximately corresponding to loads of 5, 10, 15, 20 and 25 lights. Three sets of readings were also taken with cur-

advantage more than compensates for the decreased range of its output is open to question. Further experimental evidence is however needed in this regard.

Regarding the relative amounts of iron in field and armature, we see no reason for the present practice of using so little iron in the armature, as compared with the field. The necessity of a very high field induction or a thoroughly stiff field is apparent;

but why when the lines are once generated by the field it is not sought to collect and utilize them all by means of an armature, with a generous amount of iron is not so easily seen. The number of commutator segments would of course have to be increased to prevent sparking, but the regulating qualities of the machine would, it is believed, not be impaired. The result would be a larger output and greater efficiency.

Regarding the ratio of ampere turns on field and armature, such ratio will depend largely on the shape of the pole pieces and desired width of brush, but is in all cases much less than in constant potential machines.

The characteristic curves shown in Fig. 7 were taken at the 5, 10, 15, 20 and 25 light positions of the brushes, and show that

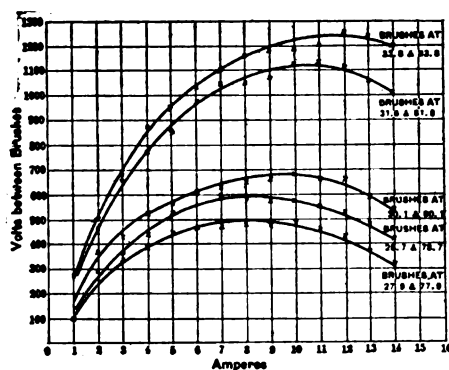


FIG. 7

with this machine regulation is almost entirely effected by shifting the brushes, as the curves droop too slowly to assist to any material extent. Of course, they might have been made to droop much more rapidly if the collecting brushes had been moved into sparkless positions for each value of the current, but a curve so obtained is not at all characteristic. The efficiency curve is given in Fig. 8. From this curve and from what we have seen of the machine it is evident that it would never pay to run machines of this type underloaded. If a number are used in one station the connections of the external circuits at the switchboard should be

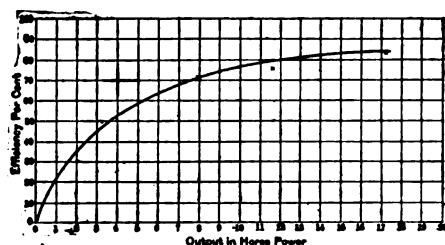


FIG. 8.

so manipulated as to keep the machines actually in use always loaded to as near their full capacity as possible.

Our thanks are due to Mr. H. J. Podlesak, who greatly assisted in taking the observations and working up the results.

CHANGE IN COMPUTING GOVERNMENT TELEGRAPH RATES.

POSTMASTER GENERAL BISSELL has issued an order fixing the rates at which official communications may be sent by the various companies during the fiscal year ending June 30, 1895, in accordance with statutes securing to the government the use of telegraph lines for postal, military and other purposes. Instead of computing the actual distances of transmission, the payment will cover the number of miles between the capital of the state or territory or the District of Columbia from within which the message is sent and the capital of the state, territory or the District of Columbia within which received. The rates are as follows:

Day messages containing not more than twenty words, exclusive of place from and date, 20 cents, not exceeding one thousand miles, and one cent for each additional word. One-quarter of this rate to be added for each five hundred miles or fraction, but no rate on a message of twenty words is to be more than 40 cents, nor on an additional word more than two cents. The rate between all points in any state, territory or the District of Columbia shall be 20 cents for twenty words and one cent for each additional word. Night messages not exceeding twenty words, 15 cents, if

distance is within two thousand miles, and for greater distances 25 cents; in each case one cent for each additional word. It is provided that if on July 1, 1894, or during the ensuing year, any company charges the public for ten words or less, exclusive of the date, address and signature, a less rate than is herein fixed for twenty words, exclusive of place from and date, the rates prescribed shall during the year be reduced by such company to the rates charged to the public. As regulated by statutes government messages are to have priority over all other business conducted over telegraph lines subject to the order.

ECONOMY IN THE BOILER ROOM.¹

BY JOHN C. MC MYNN.

I take pleasure in presenting before this body a few ideas on economy in the boiler room. I say pleasure because I consider the boiler room one of the most abused portions of the system of power generation, and I sometimes wonder why the boilers do not form a "Union," and strike. Were such a thing possible, the list of grievances would probably read as follows: non-union fuel, poor water, bad draft, inefficient attendance, out of date setting, and other minor details.

Pardon me if in this short paper I do not follow a fixed outline, but rather talk along just as if we were discussing the subject in which I have become so greatly interested in the last two years. As most of us have plants under our charge or are interested in them, I shall not take up the subject of new boiler rooms except to say that experience has shown that it is by all means good business policy for the company to secure the services of some modern consulting engineer. The brick mason in your own town will assure you on his honor (and he is doubtless sincere), that he knows all about boiler settings; in fact, has set "hundreds of them," but he is setting boilers the same to-day as he did ten or twenty years ago. I will venture the opinion that at least a saving of 15 per cent. can be effected in the setting of a horizontal tubular boiler. In looking over a series of boiler tests, I find that those boilers which are hung from I beams resting on columns and having at least a good six inch clearance between the sides and the walls give the best results,—the reason probably being that much additional heating surface is brought into use and the gases have free access to the sides of the boiler.

The question of horizontal tubulars vs. water tube boilers is one which every engineer and owner must settle for himself, for in solving the problem there are many variable quantities,—as first cost, cost of fuel, quality of fuel, amount of room, etc.

An easy way of figuring this out without considering safety is as follows: Let

- B = cost of boilers.
 - b = rate of interest on cost of boilers.
 - P = cost of boiler plant exclusive of boilers.
 - p = equal rate of interest on P .
 - A = cost of attendance per H. P.
 - C = cost of compounds and incidentals per H. P.
 - D = cost of repairs.
 - Nu = H. P.
 - Z = No. hours plant runs per year.
 - W = cost of fuel burned per H. P.
- Then total cost per H. P. would be:

$$(B - B \frac{b}{100}) - (P - P \frac{p}{100}) - Nu Az - CNuZ - D - WNuZ$$

$$Nu Z$$

Applying this formula to each particular location, the economy can be calculated. Generally speaking it is economy to enlarge a plant and burn cheaper fuel with less evaporation. The limit would be when the interest on the investment equals the saving per year. I attach some tables which have been published in *Electrical Engineering*, but which I think are handy to calculate the cost of evaporating water with different grades of fuel.

The question of safety is a most important one and is, of course, greatly in favor of the water tubes, but it is wonderful how few explosions occur from horizontal tubulars when one considers the attendance they receive in saw mills and small isolated plants.

During the last few months none of us have been able to choose our fuel, and hence have not run economically, as we have had to take what the "Union" was willing to give, and render thanks accordingly. But the question of generating steam with oil, coal and gas is one which has been open for a long time. Oil is undoubtedly the nicer fuel, as it is smokeless and requires so little attention, but whether it is the more economical depends in the first place on the price, which is as variable as a monopoly can make it, and, secondly, on the number of boilers in your battery. The attached tables are practically correct, as the cost of labor

1. A paper read before the Northwestern Electrical Association, St. Paul, Minn., July 18, 1894.

was calculated from actual experience and not for an ideal plant either in the case of oil or coal.

In Chicago gas is being used in many plants, but the Natural Gas Company takes the contract by the year and has made some very moderate contracts for the first year at least. In the Auditorium central plant the chief engineer, Mr. Cowen, tells me that he will save about \$8,000 per year by using natural gas. The boilers there were equipped with mechanical stokers, and when the strike was on only one grade of coal could be used, and, as many plants wanted this same grade the price went up to \$4.10 a ton for slack coal. If a smokeless furnace is used it seems as if it should be one which can burn any grade of coal or shavings. The Pullman Palace Car Company have made many improvements during the last year and are using the Hawley down draft with economy, as they can burn the refuse of their wood-working shops and shavings, or any grade of coal. They also put in the Warren Webster vacuum system, and are now collecting all their returns, which formerly went into the sewers.

In the modern boiler room one of the most important appliances is the feed water heater. The main points to be considered are: 1st, temperature as near 212 deg. as possible; 2d, amount of exhaust steam necessary to heat water; 3rd, ease of cleaning heater; 4th, low back pressure. There are so many first-class

neering profession. In my business as consulting engineer I hear that small sentence so often—"There is something in it for you"—that I have made it a rule to deal with no agent who insults me in that way. If a thing cannot be sold on its merits, it becomes necessary to buy its acceptance, and I cannot express my contempt for an engineer who will accept pay for his services from his employer and then betray his trust by listening to the enticing conversation of money. We have all of us used different compounds and, of course, been disappointed in some of them, but the new way is to analyze the water and have a compound made that will act to the best advantage on that particular water. How many of you know exactly what is costs you to evaporate your water,—and can distribute your station expenses. I have heard of a new plant just about to be built which has large steel bunkers holding about ten tons each, which are placed on scales and feed directly onto the boiler room floor. From this arrangement the superintendent can tell at any hour if he wishes, exactly how much fuel has been used, and with a water meter can approximately arrive at the evaporation.

In making tests a water meter should not be used and the modern plant will always have two tanks large enough for measuring the feed water, so that the engineer can try different grades of coal and intelligently advise the purchasing agent. Connections

APPROXIMATE COST OF LABOR REQUIRED IN EVAPORATING 1,000 POUNDS OF WATER.

FUEL: OIL.
ONE BOILER HORSE-POWER EQUALS 34½ POUNDS OF WATER FROM AND AT 212°.
(Robert W. Hunt & Company's Table No. 4.)

HORSE-POWER OF BOILER.	NUMBER OF BOILERS IN BATTERY.									
	1	2	3	4	5	6	7	8	9	10
75	.06194	.03997	.02064	.01548	.01239	.01008	.00755	.00536	.00385	.00288
100	.04645	.02322	.01548	.01161	.00909	.00716	.00512	.00361	.00254	.00181
200	.02322	.01161	.00774	.00564	.00444	.00365	.00276	.00212	.00154	.00106
300	.01548	.00774	.00516	.00387	.00309	.00243	.00184	.00141	.00107	.00079
400	.01161	.00580	.00387	.00290	.00232	.00184	.00141	.00107	.00079	.00058
500	.00909	.00464	.00309	.00232	.00185	.00141	.00107	.00079	.00058	.00043
600	.00774	.00387	.00258	.00193	.00155	.00119	.00092	.00067	.00049	.00036

Cost of labor per month

26 days x 12 hours x number of boilers x number of thousand pounds of water evaporated = approximate cost.

(The above table is figured for a day of 12 hours. If cost is wanted for 8-hour day, add one-half more to given amount in table. The wages are calculated as follows: Fireman, \$9 per month; water tender, \$55.)

COST OF EVAPORATING 1,000 POUNDS OF WATER.

FUEL: COAL.
(Robert W. Hunt & Company's Table No. 1.)

COAL PER TON.	\$.75	1.00	1.25	1.50	1.75	2.00	2.50	3.00	3.50	4.00
5.	.0730	.1000	.1250	.1500	.1750	.2000	.2500	.3000	.3500	.4000
5.5	.0681	.0909	.1136	.1363	.1591	.1818	.2273	.2727	.3182	.3636
6.	.0625	.0833	.1041	.1250	.1458	.1666	.2083	.2500	.2917	.3333
6.5	.0576	.0769	.0961	.1154	.1346	.1538	.1923	.2307	.2692	.3077
7.	.0535	.0714	.0892	.1071	.1250	.1428	.1785	.2143	.2500	.2857
7.5	.0500	.0666	.0833	.1000	.1166	.1333	.1666	.2000	.2333	.2666
8.	.0468	.0625	.0781	.0937	.1093	.1250	.1563	.1875	.2187	.2500
8.5	.0441	.0588	.0735	.0882	.1029	.1176	.1470	.1764	.2059	.2353
9.	.0416	.0555	.0694	.0833	.0972	.1111	.1389	.1666	.1944	.2222
9.5	.0394	.0526	.0657	.0789	.0921	.1052	.1316	.1578	.1842	.2105
10.	.0375	.0500	.0625	.0750	.0875	.1000	.1250	.1500	.1750	.2000
10.5	.0357	.0476	.0595	.0714	.0833	.0952	.1190	.1428	.1666	.1904
11	.0340	.0454	.0568	.0681	.0795	.0909	.1136	.1363	.1591	.1818

Cost of evaporating 1,000 pounds of water = Price of coal per ton (7) x evaporation.

TABLES SHOWING COST OF EVAPORATING 1,000 LBS. OF WATER WITH DIFFERENT GRADES OF FUEL.

heaters in the market to-day, that an engineer can find exactly what he wants by a little study. Of course, different heaters are suited for different plants, and the need of plants should be studied. The higher the temperature of the feed water in the heater, the more scale will be deposited in the heater and consequently less in the boiler, which is a very desirable fact, for if an engineer knows exactly where the scale is deposited he can get at it regularly to remove it. The amount of steam necessary to heat the water, of course, depends largely on the conductivity of the material between the water and the steam, and if the scale is deposited on this conducting surface, the heater will gradually but rapidly and surely lose its efficiency. A heater which cannot be cleaned of scale rapidly and easily will, of course, be neglected and allowed to become inefficient. The reduction of back pressure is a most important item, for all the economy of the boiler room may be easily more than balanced by increase of back pressure in the engine room, and at the same time the efficiency obtained from well set valves and nicely adjusted engines is overbalanced.

No other part of the supply business has been so disgraced as that of boiler compounds. It seems as if every quack remedy under the sun has been used for this, and it has become with many a mere matter of buying the engineer. And right here let me urge upon this Association the necessity of honesty in the engi-

neering profession. In my business as consulting engineer I hear that small sentence so often—"There is something in it for you"—that I have made it a rule to deal with no agent who insults me in that way. If a thing cannot be sold on its merits, it becomes necessary to buy its acceptance, and I cannot express my contempt for an engineer who will accept pay for his services from his employer and then betray his trust by listening to the enticing conversation of money. We have all of us used different compounds and, of course, been disappointed in some of them, but the new way is to analyze the water and have a compound made that will act to the best advantage on that particular water. How many of you know exactly what is costs you to evaporate your water,—and can distribute your station expenses. I have heard of a new plant just about to be built which has large steel bunkers holding about ten tons each, which are placed on scales and feed directly onto the boiler room floor. From this arrangement the superintendent can tell at any hour if he wishes, exactly how much fuel has been used, and with a water meter can approximately arrive at the evaporation.

In making tests a water meter should not be used and the modern plant will always have two tanks large enough for measuring the feed water, so that the engineer can try different grades of coal and intelligently advise the purchasing agent. Connections should be so made that any one boiler can be tested, or any combination. Blind flanges will not leak, but valves will in nearly every case. A calorimeter is such a simple instrument that any engineer can run it and know what quantity of steam he is supplying from the boilers. Thermometers should be placed in the feed pipes and watched closely. But intelligent attendance is about as important an item as any. High priced superintendents are a rule, but any "Dago" can shovel coal, and his idea of firing is to handle all the coal possible with the least effort. Raise the standard of labor in the fire-room and pay more wages, and I am sure you can reduce the number of men and save much in the fuel bill.

POWER TRANSMISSION IN MINNESOTA.

Prof. Geo. D. Shepardson, of Minneapolis, writes us:—

"The King Powder Co. of this place is concentrating its steam and water power, and erecting a central plant of about 1,000 h. p. for operating all its mills and the factories of the Peters Cartridge Co. by electric motors. The Shawhan-Thresher Electric Co. have the electrical contract; compound condensing Buckeye engine is used with water wheels."

ELECTRICITY AS A FIRE HAZARD.—VIII.

BY W. J. JENKS.

ORIGIN OF ELECTRICAL INSURANCE RULES.

I have also thought it important to secure the views of practical central station electricians from the standpoint of companies which must constantly consider the peculiar conditions which arise in distributing and selling electrical energy to the public.

One competent central station inspector, after reading the statements of the two engineers already quoted, makes the following reply :

"From the Illuminating Company's point of view, we believe permission on the part of the underwriters for a decrease of size in the conductors for the interior wiring of buildings would be very undesirable for the following reasons: We find it to be almost universally the case that after the wiring is installed for a certain number of lamps of a certain candle power, the candle power is increased, thus demanding double the amount of current. In addition to this, it is generally the case that the number of lamps is also increased, so that the copper, instead of being too heavy, as it was for the original installation, is entirely inadequate to carry the amount of current necessary to supply the final installation. No doubt the size of the wires in the tables is a little large for the amount of current which it is figured to carry, but as our experience tells us that in almost every instance the amount of this current is increased, we do not think it advisable to decrease the size of the wire. Even in cases where the wires can be readily pulled out when an increase becomes necessary, it seems doubtful whether it would be policy to cut down the amount of wire on account of the cost of labor in taking it out and putting it back again when it became necessary. Of course this latter is a question of judgment in each particular case. In case the contractors installing the wires do not get them in large enough, the Illuminating Company is held responsible for poor service and in many cases has to go to considerable expense in order to keep its service up to standard, so that, look at it in any way, it is to our interest to have the wires as large as possible."

As, therefore, in the engineering of important mechanical undertakings, a large percentage of margin of safety is and should be allowed, particularly where the exact maximum of future requirement cannot be predicted, it needs no further argument to demonstrate the soundness of the latter position, above quoted, in the field of electrical engineering. But a concise and unexpected method of expression which the student (we are all students in this electrical art) can carry away with him is ever welcome, and such is the following from the vigorous pen of one of the most widely known of municipal inspectors of electrical risks :

"I think the two engineers first quoted are both arguing rather from the standpoint of the investor-contractor than from that of the investor-owner. In other words they make it a question of dollars versus safety.

"In this city the smallest wire in use is No. 14 B. & S. except in cords or single lights with very short runs. Reinspection is daily exemplifying the wisdom of an ample carrying capacity in all conductors. I can give you two instances which occur to me just now.

"(1.) A show-house which had some 9 amperes on a wire (foot-lights) was encouraged by a drumming salesman to double the ampere flow by substituting 32 c. p. for 16 c. p. lamps, and the 'electrician' told the writer he didn't think it was anything out of the way. Only reinspection brought the fact to the surface.

"(2.) In an office building here the all-wise 'electrician' of the plant added a circuit of No. 16 wire substituting 32 c. p. for 16 c. p. until he had 36 lamps, and the fact only leaked out through the want of more light, requiring an overhauling of the plant.

"The necessity for more lamps on a circuit in an office building which is liable to change tenants every year, and to change its desk locations any time, must be watched and provided for I think. Once the plant is installed it goes out of the company's hands, and the electrical butcher who is placed in charge usually doesn't know enough to make a safe joint, and sees no reason why he cannot add lamps ad infinitum on any wire regardless of size.

"Another reason for requiring large wire lies in the fact that the plant installed for Mr. A. was originally a 110 volt 0.5 ampere outfit, and ten lamps were placed, we will say, on a No. 16 B. & S. conductor. The plant for some reason is changed to a 50 volt 1 ampere system; it is true the converter may be changed to correspond, but it seldom is unless at the order of some authority, and unless there is some such inference, 10 amperes will traverse the wire which was originally run for but 5 amperes. (5 amperes is our rule for an ultimate cutout.)

"Now experience has given us here plenty of instances in central station work similar to the above. There is a close competition in the centre of the city between the alternating and the direct current systems. The patronage is constantly shifting; to-day it is Edison, to-morrow Westinghouse or Slattery, and we are kept busy watching for results which a sufficiently large wire

and a minimum current flow would amply protect against. We are compelling reinforcement of conductors constantly.

"You may think me prolix, but I feel almost nervous at times over this carrying-capacity business when I find persons in charge of installations who are ignorant of the first principles of the science; men who think they are doing good service if they can fool an inspector and thus run the chance of burning a building; hired because they work cheap, and kept because they are time-servers and braggarts. So you will, I trust, excuse me for giving vent to my feelings in this manner."

4. A departure from absolute practical insulation of the entire generating, conducting and translating systems. If the integrity of the insulation of the dynamo and conducting wires and the lamps or motors can be depended upon, the largest number of possible difficulties will disappear. During the early years of practical electric lighting and power transmission, before experience had given confidence to investors, a prime necessity to the growth of the business was that plants should be inexpensive, and cheap methods of covering and supporting all parts of the circuit were devised and generally adopted. Experience has shown that this does not save money, and that in the long run, the owner, the user, the operator and the insurer of an electric plant will find it to their advantage to combine in requiring the constructor to put in the best material and apply the best methods which present knowledge provides. After the failure of the first electric light insulating covering which has been alluded to as "Underwriters Wire," a reaction occurred and coverings which secured the highest degrees of insulation, consisting of various forms of rubber, were devised in considerable variety. It has required the test of several years to show that none of these forms of practically moisture proof insulation are likely, if unaided by co-operative "supplemental insulation" of glass or porcelain or similar rigid material, to stand the test of time. This subject is an exceedingly fruitful one and might well form by itself the topic of another paper. It may be summarized by saying that at the present day, experience dictates that in the interior wiring of buildings where conductors are permanently covered so as to be beyond ready inspection, they should be so placed and supported that if their insulating wrapping were to entirely disappear they would still be safe in the view of the insurance underwriters. Among other ways in which this desirable result may be obtained, two are worthy of special mention, because they are within the reach of every constructor and one or the other may be applied in every case.

(a) The support of conductors at a proper distance from each other and from conducting material by moisture-proof non-combustible insulation, such as glass or porcelain. The introduction of such material in the manufacture of switch bases, fuse blocks, socket insulation, cleats and knobs, marks an epoch in the business of distributing powerful electric currents. Taken in connection with the use of fire-proof frames for resistance coils and small devices, it is one of the greatest practical advances made within the past ten years in this field. The high insulation obtained by the use of glass or porcelain sometimes causes an accumulation of finely subdivided particles of lint or dust upon the electrified wires. Such conductors in some manufacturing establishments, if not regularly cleaned, become channels for the spread of fire, and should be considered in any inspection of risks of this class.

(b) The enclosure of well insulated conductors in conduits or wire-ways. The present rules of the underwriters set forth that the "object of a tube or conduit" for interior wiring "is to facilitate the insertion or extraction of the conductors, to protect them from mechanical injury, and, as far as possible, from moisture." It is a serious question for the insurance inspector to determine whether there is any method now practiced which secures these results, or whether there is any system or form of construction now in general use in which the tubes do not contain within themselves the elements of their own destruction. It is evident that if conductors are to be capable of ready removal for inspection or replacement, they must be so well insulated from each other and from the tube with which they may be surrounded as to resist the tendency to leakage or short circuit which is produced by the pressure of the particular system to which they are to be applied. Frequent difficulties arise from the disturbance of such tubes by carpenters, masons, gas-fitters and other mechanics who make changes in the surroundings after the tubes have been placed. Is there not a suggestion of a cheap and useful form of conduit for this work, in the fact that for ten years or more the metal pipes of fixtures carrying electric lamps have supported and mechanically protected the wires by which these lamps have been fed?

We have only to consider how the portion of the interior conducting system which can be removably enclosed and protected can be extended from the short length which we now place within the fixture pipes, to the entire length from the lamps back to the service (or junction of the interior conductors with underground or overhead distributing wires) for which extensions of these fixture pipes from the ceiling outlet to the point of supply of the building would provide. Can it not be presumed that if by closing the upper end of the fixture stem with a water-tight plug we

have been able for the past ten years to keep the enclosed wires running through that pipe in good condition, so that they have neither short-circuited between themselves nor grounded upon the fixture metal, we can make an entire system of distributing tubes of gas pipe without encountering serious engineering difficulties? For such a purpose it may be found desirable to use a separate tube for each wire or polarity, particularly in a case of those conductors which carry current for many lamps, but it seems probable also that with concentric conductors having one polarity forming a core and the other wound in a long spiral around it, and separated by carbonizable material (and not by rubber and similar moisture-proof material) the twin conductor thus formed being covered with such insulation as to be impervious to moisture, we should have a cheap and at the same time reliable variety of wire. Assuming that the lengths of piping might be joined by non-conducting unions so that a ground connection on one length would not affect others in the same line, and that in this way the electrical strain which ordinarily exists between the outside conductor and the pipe would in this system be practically absent, we should have no tendency to leakage except from the outside to the inside conductor through the carbonizable insulation.

If by any means this insulation should fail, the reduction of it to carbon would insure an arc of very low resistance amounting practically to an absolute short circuit, which would also be assisted by the enclosure of the generated gas within the surrounding iron pipe. Under these circumstances the immediate fusing of a suitable safety wire would be a certainty, and thus any possible difficulty would be confined to a single line of such a tube. If this suggestion be not, in all its detail, entirely feasible at this moment, may it not be so worked out as to become so?

PROF. J. J. THOMSON ON THE ELECTRICITY OF DROPS.

DROPS afford many advantages for the investigation of electrical effects, especially of those which involve the contact of dissimilar substances. Perhaps the greatest of these advantages is that when the drops are formed they present a perfectly clean surface to the gas by which they are surrounded so that the conditions are much more definite than they can be when the surfaces have been long exposed, and have had time to get contaminated by dirt or coated with films. These advantages have commended the study of the electricity of drops to Prof. J. J. Thomson, of Cambridge, who contributes an exceedingly interesting paper on his results to the April issue of the *Philosophical Magazine*.

The subject has already received some attention from Lenard (*vide Wiedemann's Annalen*, xlv., p. 584), and Prof. Thomson has largely made use of the methods of experiment adopted by this physicist. The experiments described by the latter relate to the electrical effects which occur when a drop of liquid falls upon a plate already coated with a film of the same liquid.

At the foot of waterfalls, as is well known, peculiar electrical effects occur. Here the normal distribution of the atmospheric electrical potential is disturbed in such a way as to indicate a distribution of negative electricity in the region at the foot of the fall. These effects cannot be due to the waterfall acting like the falling drops in Lord Kelvin's water-dropping electrophorus; for they are found to occur when the waterfalls are inside caves whose sides are dripping with moisture, in which case the water would be falling inside an equipotential surface. This notion is the starting point of Prof. Thomson's investigation.

Without following the professor through the details of his exhaustive experiments, we may turn with advantage to his results. They show that the electrification developed by the drop depends (1) on the nature of the gas surrounding the drop; (2) on the nature of the drop itself. On the drop side of the surface of separation of the gas and drop there is a coating of one kind of electricity close to this, but in the gas there is a coating of the opposite kind of electricity. The quantity of positive electricity on one coating is equal to the quantity of negative electricity on the other.

Experiments with liquids of various chemical constitutions point clearly to the conclusions that the electrification owes its origin to chemical processes. Over the surface of the drop a substance is formed which is in a state intermediate between that of complete chemical combination and complete separation between the surrounding gas and the liquid forming the drop; a state in which the constituents have electrical charges of the same sign as in actual chemical compounds, but in which the connection between the constituents is so loose that they can easily be shaken apart. The greatest electrical effect will occur when there is a tendency towards chemical combination, though not of sufficient intensity to result in the time taken by the drop to fall from its starting point to the plate, in the formation of a definite chemical compound. The quasi-chemical action which produces the electrification is greatly influenced, if not altogether determined, by the solvent.

Prof. Thomson argues that distilled water, concerning which electricians have hitherto held pronounced views, is a substance which is far from being chemically saturated and inert, but that, on the contrary, it can by its chemical action set up those chemi-

cal changes in the gas by which it is surrounded or in substances dissolved in it which give rise to electrification. This argument is illustrated mathematically by curves. There seems no reason for limiting the possession of this double coating to liquids. It is possessed by liquids of the most diverse characters, as is shown by the electrification developed by drops of water, mercury, molten metals, turpentine, etc. If, however, we suppose that solids possess such a coating, it is evident that the rubbing off of part of one of these coatings when two solids are rubbed together, would show itself as electricity developed by friction. Indeed, it seems possible that a large part, if not the whole, of the electricity developed by friction may be due to this cause.

The author concludes his paper with some speculations concerning the electrification of metals, etc., when exposed to the influence of ultra-violet light, and concerning the origin of the large drops of rain which frequently accompany thunderstorms.

THE ROTATION OF THE ELECTRIC ARC.¹

BY A. P. TROTTER.

IN the course of experiments made with the view of realizing as a practical standard of light, the method of using one square millimetre or other definite area of the crater of the positive carbon of an electric arc,² the author has found that the effective luminosity is not, as theory would predict,³ either constant or uniform. By the use of a double Rumford photometer, giving alternating fields, as in a Vernon Harcourt photometer, his attention was called to a bright spot at or near the middle of the crater. The use of rotating sectors accidentally revealed that a periodic phenomenon accompanied the appearance of this bright spot, and although it is more marked with a short humming arc, the author believes that it is always present.

An image of the crater was thrown on a screen by a photographic lens; and a disc having 60 arms and 60 openings of 8°, and rotating at from 100 to 400 revolutions per minute, was placed near the screen. Curious stroboscopic images were observed, indicating a continually varying periodicity seldom higher than 450 per second, most frequently about 100, difficult to distinguish below 50 per second, and becoming with a long arc a mere flicker. The period seemed to correspond with the musical hum of the arc, which generally breaks into a hiss at a note a little beyond 450 per second. The hum is audible in a telephone in the circuit, or in shunt to it. The current was taken from the mains of the Kensington and Knightsbridge Electric Light Company, often late at night, after all the dynamos had been shut down. The carbons were, of course, not cored; six kinds were used.

A rotating disc was arranged near the lens, to allow the beam to pass for about 1/100th of a second, and to be cut off for about 1/100th of a second. It was then found that a bright patch, occupying about one quarter of the crater, appeared to be rapidly revolving. Examination of the shape of this patch showed that it consisted of the bright spot already mentioned, and of a curved appendage which swept round, sometimes changing the direction of its rotation. This appendage seemed to be approximately equivalent to a quadrant sheared concentrically through 90°. Distinct variations in the luminosity of the crater are probably due to the fact that this is only an approximation.

The *a priori* theory of the constant temperature of the crater is so attractive, that the author is inclined to attribute this phenomenon, not to any actual change of the luminosity of the crater, or to any wandering of the luminous area, as is seen with a long, unsteady arc, but to the refraction of the light, by heated vapor. All experiments, such as enclosing the arc in a small chamber of transparent mica, or the use of magnets, or an air blast, have failed to produce any effect. A distortion of the image of the crater while the patch revolves, has been looked for, but nothing distinguishable from changes of luminosity has been seen.

An unexpected difficulty is thus introduced in the use of the arc as a standard of light, and one which may interfere with its use under some circumstances as a steady and continuous source of light. The author is further examining this phenomenon with the view of ascertaining its nature, and of finding practical conditions under which it is absent or negligible.

A NEW ATMOSPHERIC GAS.

A CABLE despatch states that Lord Rayleigh and Prof. Ramsay have announced the discovery by them of a new element in the atmosphere. It is a dense and remarkably inert gas twenty-one times heavier than hydrogen and 50 per cent. heavier than nitrogen. The spectrum is new, showing a single blue line much more intense than the corresponding line in the nitrogen spectrum. It constitutes about one per cent. of the atmosphere.

1. A Paper read before the Royal Society.

2. J. Swinburne and S. P. Thompson, discussion on Paper by the Author, "Inst. Electrical Eng., Vol. XXI., pp. 384 and 408.

3. Abney and Festing, *Phil. Trans.*, 1881, p. 890; S. P. Thompson, *Soc. Arts Jour.*, Vol. XXXVII., p. 353.

THE ELECTRICAL ENGINEER.

[INCORPORATED]

PUBLISHED EVERY WEDNESDAY AT
303 Broadway, New York.

Telephone: 3860 Cortlandt.

Cable Address: LEENGINEER.

Gen. M. PHILIPS, President.

F. B. COLVIN, Treas. and Business Manager.

Edited by

T. CONMERFORD MARTIN and JOSEPH WETZLER.

Associate Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue,
Boston, Mass.Western Editor and Manager C. KAMMEYER, 1430 Monadnock Building, Chicago,
Ill.New York Representative, 303 Broadway, } W. F. HANKS.
Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada	- - - - -	per annum, \$3.00
Four or more Copies, in Clubs (each)	- - - - -	2.50
Great Britain and other Foreign Countries within the Postal Union	- - - - -	5.00
Single Copies,	- - - - -	.10

[Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1893.]

EDITORIAL ANNOUNCEMENTS.

Addresses.—Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of THE ELECTRICAL ENGINEER. Communications for the attention of the editors should be addressed, EDITOR OF THE ELECTRICAL ENGINEER, 303 Broadway, New York City.

VOL. XVIII. NEW YORK, AUGUST 22, 1894. No. 329.

CONTENTS.

EDITORIAL:—

PAGE.

Iron Wire in Dynamo Electric Machines.....	150
Section 4897 Again.....	151
Electricity as a Sealed Mystery.....	151
Leaderette.....	151

ARTICLES:—

Magnetic Leakage in Dynamo-Electric Machinery.—I..... A. E. WIEBER.	141
The Resonance of Electric Circuits (Illustr.)..... W. A. ANTHONY.	143
Balancing Turbines Magnetically (Illustr.).....	144
Test of a Closed Coil Arc Dynamo (Illustr.).....	144
Economy in the Boiler Room..... J. C. MC. MYEN.	146
Electricity as a Fire Hazard.—VIII. (Illustr.)..... W. J. JENKS.	148
Prof. J. J. Thompson on the Electricity of Drops.....	149
The Rotation of the Electric Arc..... A. P. TROTTER.	149
Annual Meeting of the Association of Edison Illuminating Companies....	154

ELECTRIC TRANSPORTATION DEPARTMENT:—

The Boynton Bicycle Electric Railway (Illustr.)..... J. M. KWOX.	153
An Electric Railway Store Service.—Electric Railway Work in Ohio.—	
Postal Trolleys in Brooklyn.—Power House for Baltimore Tunnel.—	
Electricity vs. Cable in Power Transmission.—To Haul Coal by Trolley in Pennsylvania.—Chicago Trolley Ordinance Accepted.....	153

NEWS AND NOTES:—

French Atlantic Cable Project.....	142
Change in Computing Government Telegraph Rates.....	146
Power Transmission in Minnesota.....	147
A New Atmospheric Gas.....	149
The Pacific Cable.....	156
E. P. Thompson, M. E.....	156

LITERATURE:—

Official Report of the Frankfort International Electrical Exhibition, Vol. II	155
---	-----

SOCIETY AND CLUB NOTES:—

American Electro-Therapeutic Association.....	155
Meeting of the A. A. A. S.....	155

LETTERS TO EDITOR:—

Properties of Electrolytic Copper..... F.	156
Where Mr. Edison Left Off..... IN THE DARK.	156

PERSONAL:—

Prof. S. P. Langley.....	156
--------------------------	-----

INVENTORS' RECORD:—

Classified Digest of U. S. Electrical Patents Issued August 14, 1894. . . .	157
---	-----

TRADE NOTES AND NOVELTIES AND MECHANICAL DEPARTMENT:—

The New Livgro Incandescent Lamp.—The Mather Electric Co.'s Works.	
—The Germania Lamp Factory.....	156
Failure of T. W. Ness & Co.—Niagara's Power for Canada.....	157
The Strong Return Tubular, Internally Fired, Boilers (Illustr.).—General	
Electric Marine Lighting Combination (Illustr.).—The New "Steel"	
Railway Motor Controller (Illustr.).—Columbia Electric Co.....	159
The Manhattan Incandescent Arc Lamp (Illustr.).—Western Notes.—New	
York Notes, ...	160

IRON WIRE IN DYNAMO ELECTRIC MACHINES.

It has been pointed out as one of the triumphs of electrical engineering that the efficiency of the dynamo and electric motor is greater than that of any other type of energy transformer, and indeed has been brought to so high a pitch that little if any advance can be looked for. But having attained this desired goal it does not by any means follow that there is nothing left to be done in the construction of dynamo electric machinery. There are not a few who are striving for still further simplicity and capacity per pound of material employed and, above all, for cheapening the cost of manufacture. It is with the latter object in view that Mr. Gilbert Wilkes,—in a recent lecture delivered before the engineering students at the University of Wisconsin,—recommends the use of iron wire both on the armature and fields of small machines, that is, not exceeding 5 H. P.

It is certain that the winding of an armature with iron wire will materially reduce the reluctance of the gaps, and therefore will economize in exciting power, for two reasons: First, directly, by lessening the total reluctance of the magnetic circuit, of which the air gap is the most prominent portion; and, second, indirectly, by reducing the magnetic leakage of the machine, which is the quotient of the sum of the permeances of the stray paths by the permeance of the useful path, the latter being practically equal to the reciprocal of the reluctance of the gap spaces. Magnetically, therefore, the use of iron wire in the armature offers a great advantage over copper. On the other hand, it is to be considered that the electrical resistance of iron is about seven times that of copper, and that, therefore, for the same current output, the iron wire would require to have seven times the sectional area of the copper wire. This, of course, increases the height of the winding space and, consequently, the external diameter of the armature, which in turn will increase the size of the whole machine. Since the armature resistance will be practically the same if the cross-section of the iron is chosen at seven times that of copper, the $C^2 R$ loss will be the same in both cases; but, the whole armature being one mass of iron in the former case, the energy-loss due to hysteresis and to eddy currents will be considerably larger, causing more heat generation than in a copper wire armature. If the size of the armature is such that this increase in heat is within the limits of the increase of the size of the radiating surface, then the temperature increase of the armature, in running, will not be materially different for the two materials of the armature wire. This consideration will at once determine the limits as to size of machine and of the application of iron wire to the armatures of small machines.

Another advantage of using iron wire in small machines is the increase of the effective length of the armature conductor. In order to limit the leakage across the polepieces, the distance between the pole corners must be larger than the length of the two gap-spaces; and since in small copper wound armatures this length is comparatively large, the distance between the pole corners is excessive compared with large dynamos, and therefore the percentage of the effective polar arc is very small in the small machines. In using iron wire, this distance between the pole-corners

may be considerably decreased, and a larger portion of the armature circumference rendered useful, thus increasing the effective length of the armature-conductor, whereby—in a generator—a correspondingly larger *x. m. f.* output is obtained. It would thus seem that there are many advantages in favor of using iron wire for winding the armatures of small dynamos, and we, therefore, think it worth while to investigate this matter further by experiment.

As to the use of iron wire for winding the field cores, we fail to see any advantage. On the contrary, the winding of the magnets with iron wire would reduce their distance from iron to iron, and increase their iron surface, thus lessening, in a high degree, the reluctance between them. In the armature, this reduction of the reluctance is the chief advantage of the iron wire, as it applies to the useful path, while, if applied to a stray path, it becomes a most serious disadvantage, especially in small dynamos. For in these, the naked cores in themselves offer a comparatively much greater surface than in large machines, and the leakage between them is therefore much larger in comparison; and if this already large leakage is still further increased by winding the cores with iron wire the gain in using iron for the armature may eventually not only be entirely cancelled, but the leakage may be larger than when using copper wire. We therefore cannot agree with Mr. Wilkes in recommending the use of iron wire for winding the field cores of small dynamos, but we feel sure, that its application for winding small armatures will prove successful.

SECTION 4887 AGAIN.

COMMENTING upon a bill introduced by Congressman Hall, of Minnesota, to amend the present patent law, and commending some of its features, *THE ELECTRICAL ENGINEER* of May 9, 1894, said:

An important, and perhaps questionable, provision, apparently inserted for the benefit of some of the leading electrical corporations of the country, is that no patent *now in force*, or hereafter granted, shall have its term limited by the term of a prior foreign patent for the same invention, unless the date of the foreign patent is prior to that of the *application* of the domestic patent. The circuit courts, it will be remembered, have held that the date of the foreign patent relates to the date of issue and not that of application of the domestic patent, and this much vexed question is now before the Supreme Court of the United States for final decision on appeal.

It was the retroactive character only of this provision that we deemed "questionable." If enacted it would apparently secure by legislation a full term of seventeen years to a number of telephone patents and to the Edison incandescent lamp patent, which patents would, under existing law, as interpreted by the Circuit Courts of the United States, expire with corresponding foreign patents at much earlier dates. It is quite clear that the American Bell Telephone Company and the General Electric Company would gain a great advantage as against the public by such retroactive legislation. Users of telephones and of electric lamps, as well as prospective competitors in their manufacture and sale, should be secure in their reliance upon existing law as applied to existing facts by the United States Courts.

In view of the present temper of Congress and the country it is not very likely that any amendment of the patent law will be effected before the close of the session;

but it is well to keep the subject in mind and to keep a watch on possible further action. In addition to the bill noticed herein there are four others before the House of Representatives for amending the patent law, all of them modifying Section 4887.

Mr. Charles H. Aldrich, of Chicago, sometime Solicitor General during the Harrison administration, has memorialized Congress in opposition to the proposed amendment of Section 4887, and especially against the retroactive feature, pointing out with much force the inequity to the public that would follow its enactment.

Our readers are aware that the Bell Company and the General Electric Company—whose consummately able counsel leave no stone unturned—hope to secure from the Supreme Court of the United States, in the appeal of the Bate refrigerator case, an interpretation of Section 4887 making the date of application of a domestic patent controlling, instead of the date of issue as held by the Circuit Courts.

Legislation on this point can well await the judgment of the Supreme Court.

ELECTRICITY AS A SEALED MYSTERY.

It seems rather late in the day for an electrical convention to be sitting with closed doors, but the Edison Association has chosen to enforce again this year its policy of reserve and secrecy, and has, perhaps, been even closer-mouthed than before. The Association is well within its powers in sitting behind barred doors, and if it so chooses there is no one to say it nay; but we may be permitted to express the opinion that it gains little by such action and attitude. We have read through several printed reports of the Edison Association, issued by itself, and have not yet encountered anything in the bulky annual volumes to warrant such ultra-privacy. Part of the transactions, it is true, deal with affairs not necessarily public; but the largest portion is of an entirely harmless, innocent and sedative nature, and its publication at the moment when interest in it is fresh and ripe could only be productive of general good.

Such a policy of excluding the public may be carried too far, as in this instance. Even the United States Senate has "lucid intervals" in enforcing its rules as to executive session and on the whole tends to common sense treatment of the matter; so that when it does actually close its doors people know that there is pretty good reason for so doing. We venture to hope that the Edison Association may prolong its years of usefulness by becoming more and more public in its proceedings, and may not share the fate of the old Telephone Association, which first shut its doors and then shut up altogether.

Magnetic Leakage.

In this issue we begin the publication of a short treatise on "Magnetic Leakage in Dynamo-Electric Machinery," from the pen of Mr. A. E. Wiener, whose long experience in the design of dynamo machines makes him eminently qualified to discuss the subject. Upon the leakage factor depend the dimensions of the machine and the exciting power of the field, that is, practically, the entire design. Modern multipolar machinery especially is largely affected in its design by the consideration of the magnetic leakage factors and hence the timeliness of Mr. Wiener's article, which takes up and discusses probably every type of dynamo machine thus far employed in practice.

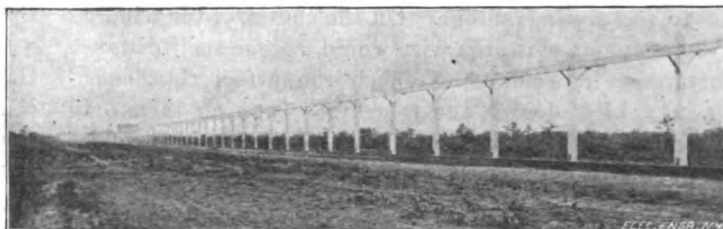
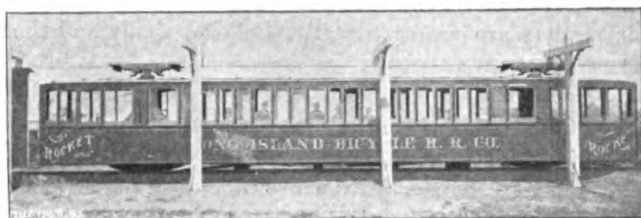
ELECTRIC TRANSPORTATION DEPARTMENT.

THE BOYNTON BICYCLE ELECTRIC RAILWAY.

BY J. M. KNOX.

THE Boynton Bicycle Electric Railway is at present an experimental line running for a mile and a half in East Patchogue, L. I.

Patchogue, is some 50 feet long, 4 feet wide and 7 feet high. The wheels, to one of which the motor is directly coupled, are journaled in a framework having no rigid connection with the car, but carrying four rollers, which press against bearing pieces fastened at right angles to each other in the car frame. This



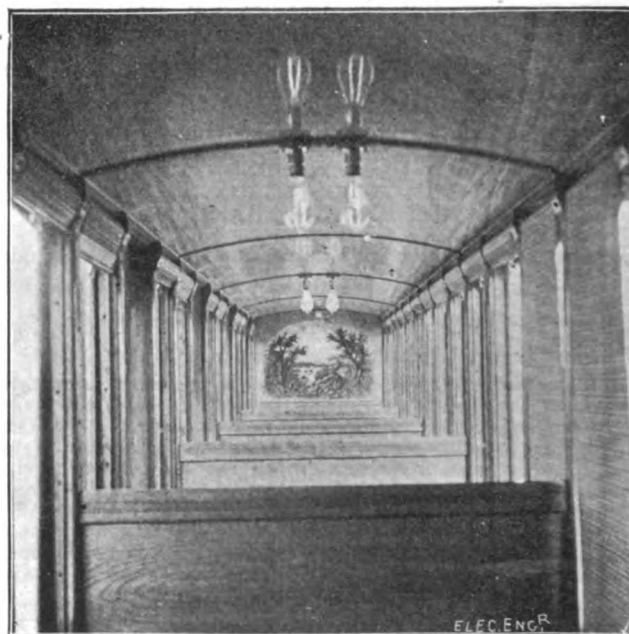
THE BOYNTON BICYCLE ELECTRIC RAILWAY.—SIDE VIEW OF CAR AND SECTION OF ROAD STRUCTURE.

It is the aim of the inventor "to simplify and reduce friction, thereby largely increasing safety and speed and saving wear and tear on both rolling stock and track."

The components of this friction in the ordinary railway system are air resistance, lack of parallelism in the two rails, direct friction on the rail due to the weight of the car, and the friction owing to jamming, skidding, etc., when rounding curves. In the Boynton system the car is made wedge-shape and very narrow. This greatly decreases the air resistance, and as the entire car with motor weighs but six tons, the friction due to weight is much reduced. The bicycle construction does away with all jamming and skidding on curves. The further advantages claimed are: More strength with less weight; speed and economy of transportation, with reduced cost of construction; a greater proportion of paying to non-paying loads; a great increase of speed (200 miles per hour); greater safety and smoothness of motion; saving in consumption of fuel, etc.

The car, as run on the company's experimental line in East

arrangement allows considerable freedom of lateral rotation for the wheels. From each of the frames in which the wheels are journaled, a vertical shaft rises through the roof of the car and carries a second framework with four guide wheels



BOYNTON BICYCLE RAILWAY.—INTERIOR OF CAR.



BOYNTON BICYCLE RAILWAY.—END VIEW OF CAR.

revolving in the horizontal plane, two on each side of and about half an inch from a 7 x 9 inch guide beam which, with its supports, forms the superstructure of the road and carries the conductor. When the car is at full speed the guide wheels only occasionally come in contact with the guide beam, as, owing to the gyroscopic action of the wheels, etc., the car tends to keep in equipoise. In rounding curves they turn the vertical shafts and thus the frame works in which the wheels are set. The car body is swung from these vertical shafts by springs, the shafts having ball bearings immediately below the points where the springs join them.

To provide against accident, the car has grooved shoes at top and bottom, so that if a wheel were to break, the car would simply fall an inch or two and then skid along the track, there being no danger of its leaving the rail or falling over, the one shoe holding by the guide beam and the other at the rail.

The overhead conductor in this system consists of a twelve pound rail imbedded up to the head in an insulating material, allowing only a narrow slot for the current collector to enter. The current is taken off by four wrought iron shoes of three square inches contact surface each. It is stated that even at the high

speed looked for by the inventors there is no danger of the shoes leaving the conductor.

The motor is a Gramme ring, series wound machine with 1,156 turns of No. 7 wire on the armature, the inside diameter of which is $36\frac{1}{2}$ inches. The field magnet is a solid steel casting of circular cross section placed inside the armature and wound with 210 turns of No. 5 wire; there are 193 commutator segments.

With regard to the commercial practicability of the system, it is claimed that it is very economical. The line in East Patchogue, however, is not efficient under the present conditions. The motor was built for a normal speed of 560 revolutions per minute, but it is unable to maintain more than about one-half of this speed, the car traveling at about fifty miles per hour; this may, in part, account for the large expenditure of energy necessary to run the car. Indicator diagrams taken from the engine which the company had in 1893 (100 H. P. New York safety) show that the engine was working at a very heavy load, but the actual electrical output it was impossible to learn, the station ammeter needle running up as far as it could go, 200 amperes being the last scale division, the voltmeter at this time reading about 400 volts. As near as could be ascertained the maximum output at any one time while the car made its trip was 85 K. W. and the minimum 80.5 K. W., the average being 82.5 K. W., or about 111 H. P.

It should be stated that the company is building a new motor to replace the one now in use.

AN ELECTRIC RAILWAY STORE SERVICE.

In the August 1 issue of the *ENGINEER* there appears a description of a small electric railway, in operation at Dellwood, Minn. The details of a railway on a still smaller scale have been kindly furnished us by Mr. E. M. La Boiteaux, of Cincinnati.

The "road" in question is in daily operation doing duty as a package carrier in the large dry goods house of the Alms & Doepke Co., of Cincinnati, Ohio. The track is an elevated one, twelve feet above the floor, and is suspended on brackets attached to the floor supports and also by rods extending from the ceiling. The rails are of ordinary angle iron, clamped to wooden strips, which are fastened to the brackets, and is of eighteen inch gauge. The car body is six feet long by two feet wide, and is supported on two pivotal trucks, the front truck being equipped with two one-eighth horse power shunt-wound motors running in parallel.

Current is delivered through one rail to insulated rings on the axles, and through contact brushes to the motors, and returns by the same method to the other rail. The motors are placed end to end, one shaft being common to both, and transmit power through single-reduction raw-hide gear and steel pinion, to the axle. Power is also communicated to the front axle by connecting rods.

The motor truck carries a small platform, upon which is placed the reversing mechanism and switch. Current to operate the reversing switch is obtained through a trolley running on a No. 12 copper wire, held on supports in the middle of the track. The back truck carries a coil, of novel construction, which, through a plunger, actuates the brake levers and, when current is on, releasing the pressure of the shoes. Current at 110 volts is taken from the company's private plant, the motors, together, taking $2\frac{1}{4}$ amperes. The platform of the car is surmounted by an ornamental railing, and all metal parts exposed to view are silver plated.

Situated at different points along the track circuit are ten stations, each in charge of a boy, who, upon the receipt of unwrapped purchases at his station, immediately signals the car operator, who is stationed at a prominent point overlooking the various stations. The operator has under his control two switches—a starting and regulating and a main automatic reversing switch—and upon receiving a call, sends the car around to the station that has signalled. If the operator receives a call from a station he has just passed, instead of running around the complete circuit, he reverses the car and it backs around to the station wanted. The goods are hauled to the main wrapping counter, where they are done up and then distributed by the car to the counters where they were purchased. The main switch controls the speed of the car, ranging from 100 to 250 feet per minute. On its trial trip, the car demonstrated its capacity by hauling a man weighing one hundred and sixty pounds, and rounding one curve of five feet radius with ease.

The car and its equipment was built by the La Boiteaux Electric Motor and Fan Co., of Cincinnati, and was installed by Mr. W. Blanhorst, the engineer and electrician of the Alms & Doepke Co., and has been in practical operation for a year and a half, giving entire satisfaction.

ELECTRIC RAILWAY WORK IN OHIO.

The Sandusky Valley Electric Railway Company is surveying the route of a proposed electric railway from Port Clinton, on Lake Erie to Marion, Ohio. The towns through which the proposed railway will pass are Port Clinton, Sandusky, Fremont, Tiffin, Upper Sandusky and Marion.

POSTAL TROLLEYS IN BROOKLYN.

The two new postal trolley cars for Brooklyn whose trial trips took place recently will greatly facilitate the free mail deliveries at Parkville, Bensonhurst, and other towns of New Utrecht and Gravesend, recently annexed to Brooklyn. The mails for South Brooklyn, the Twenty-ninth ward, and the other suburban parts of Kings county will be carried and dropped at the proper destinations, and the Post Office and the railroad officials will note carefully the operations of the car for the purpose of making improvements.

The cars are painted white with gold lettering and narrow red trimming. Each is twenty-eight feet long. The interior is divided into two compartments, each ten feet long. One section has been fitted up with side seats as a smoking room. The railroad post office section resembles the interior of a regulation postal car on a small scale. On one side are frames for the mail bags, and, on the opposite side is a wide table and a case of forty pigeon holes. There will be one postal clerk to each car.

The mail bags will be received from the stations through an open window on each side of the car and deposited in the same manner. The mail clerk will be as isolated as the postal clerk on the regulation railway post offices, as there is no connection between the mail and the smoking compartments. The cars, which are numbered 101 and 102, cost about \$1,900 each. They are both lighted and heated by electricity.

POWER HOUSE FOR BALTIMORE TUNNEL.

Excavations are now being made at Baltimore for the power-house to be used in operating the Belt Railroad. It will be a one-story brick-building. It will have a front of 389 feet on Howard street, 69 feet on Henrietta street, and 58 feet on Montgomery street. The boiler-room will 98 feet long and 69 feet wide, and will be fitted with automatic conveyers for coal. The machinery room will be 240 feet long and 58 feet wide. The equipment of the building will include eleven 250-h. p. boilers, with a fifty-foot smokestack and mechanical draught.

The engine room will contain four 750 h. p. Corliss compound engines coupled direct to four 700 h. p. multipolar generators, which will furnish the electric power for locomotives and also for lighting the tunnel. In addition there will be four 250 h. p. Armington & Sims compound engines, two of which will drive eight 50 arc-light machines, each light having 2,000 candle power. These lights will be used at Mount Clare, Locust Point and Camden Station. Each of the remaining two engines will be used to drive two generators capable of lighting 2,000 sixteen-candle-power incandescent lamps for use in the new depot at Bolton lot and other places along the line. Provision will also be made for an extra 700 h. p. generator.

It is said that the motive power for the tunnel trains will consist of three locomotives having two trucks each, each truck to be equipped with two 800 h. p. electric motors. The power-house was designed by Baldwin & Pennington. The electrical equipment was designed by the General Electric Company, and is now being made at the company's shops at Schenectady, N. Y.

ELECTRICITY VS. CABLE IN POWER TRANSMISSION.

MR. L. B. STILLWELL in a recent discussion of electric railroad questions says:—One of the most instructive comparisons we can make, and one that is, perhaps, the most definite to practical railroad men, is the power of transmission of the cable. A steel cable $1\frac{1}{2}$ inches diameter, traveling twelve miles an hour, can transmit nearly 2,000 horse-power—it would break with 2,000 horse-power. But if we take a copper wire, having a section of one square inch, and apply to it such a potential as is practically in use to-day in at least one place in this country—10,000 volts—at 1,000 amperes to the square inch, we find we are transmitting in an invisible form over that wire over 18,000 horse-power, which is enough to rupture instantly six cables such as are used ordinarily in our cable traffic. We may also make a comparison with some of the large dynamos at the World's Fair, where 1,000 horse-power was transmitted through a 6-foot belt running at a speed of a mile a minute. We can transmit through a copper wire having one inch area, as much power as you can transmit through six of those belts.

TO HAUL COAL BY TROLLEY IN PENNSYLVANIA.

Cuyler Bros., Hazleton, Pa., have received from Cox Bros. & Co. the contract to open up another large stripping at Buck Mountain. It is proposed to hoist the coal on a four-tracked plane and transport it to breaker on trolley cars. About 500 men will be employed.

TROLLEY ORDINANCES ACCEPTED.—The final contract between the city and the Chicago City Railway Company, in accordance with the provisions of the trolley ordinance passed by the Council July 16th, was approved on the 27th ult., the road filing its acceptance of all six of the ordinances, as well as the necessary bonds. It is expected work on the new lines will shortly begin.

ANNUAL MEETING OF THE ASSOCIATION OF EDISON ILLUMINATING COMPANIES.

THE ASSOCIATION OF EDISON ILLUMINATING COMPANIES convened, in annual meeting, at the Hotel Vendome, Boston, August 14. The sessions continued throughout Tuesday and Wednesday, and Thursday 16th was devoted to excursions and entertainment.

The following were in attendance:

W. M. ANTHONY, Chicago Edison Co., Chicago, Ill.
 E. A. ARMSTRONG, Camden Electric Light Co., Atlantic City, N. J.
 W. S. BARSTOW, Edison Electric Illuminating Co., Brooklyn, N. Y.
 M. A. BEAL, Forest City Elec. Light & Power Co., Rockford, Ill.
 JOHN I. BEGGS, The Cincinnati Edison Electric Co., Cincinnati, Ohio.
 GEORGE CATO, Detroit Ill. Co., Detroit, Mich.
 W. S. CLARK, General Electric Co., Schenectady, N. Y.
 J. A. COLBY, Des Moines Edison Light Co., Des Moines, Iowa.
 C. L. EDGAR, Edison Elec. Ill. Co., of Boston, Mass.
 H. T. EDGAR, Edison Elec. Ill. Co., of Atlanta, Ga.
 W. L. R. EMMET, General Electric Company, Schenectady, N. Y.
 LOUIS A. FERGUSON, Chicago Edison Co., Chicago, Ill.
 A. W. FIELD, Edison Electric Light Co., Columbus, O.
 W. H. FRANCIS, Edison Electric Ill. Co. of Boston.
 C. P. GILBERT, Detroit Illuminating Co., Detroit, Mich.
 S. D. GREENE, General Electric Co., Schenectady, N. Y.
 R. S. HALE, Edison Elec. Ill. Co. of Boston.
 CARLYL D. HASKINS, General Electric Company, Boston.
 A. L. HAWLEY, Union Electric Co., Seattle, Wash.
 ALBERT B. HERRICK, General Electric Co., Schenectady, N. Y.
 CHAS. T. HUGHES, General Electric Company, New York.
 F. E. JACKSON, Edison Elec. Ill. Co., Brooklyn, N. Y.
 W. J. JENKS, General Electric Co., New York.
 A. E. KENNELLY, Philadelphia, Pa.
 A. S. KNIGHT, Edison Elec. Ill. Co. of Boston.
 J. W. LIEB, Jr., Edison Elec. Ill. Co. of New York.
 R. LINDSAY, Cleveland Elec. Ill. Co., Cleveland, O.
 J. R. LOVEJOY, General Electric Company.
 JOHN B. MARKLE, Edison Light Co., Grand Rapids, Mich.
 WILLIAM D. MARKS, Edison Elec. Ill. Co., Philadelphia, Pa.
 J. WILLARD MORGAN, The Electric Light Co. of Atlantic City, Camden, N. J.
 I. E. MOULTROP, Edison Elec. Ill. Co., Boston.
 A. D. PAGE.
 CHARLES E. PATTISON, Edison Elec. Ill. Co., Boston.
 A. G. PIERCE, Edison Elec. Ill. Co., Boston.
 CHAS. B. PRION, New Bedford Gas & Edison Light Co., New Bedford, Mass.
 J. B. PYLE, Edison Elec. Ill. Co., West Chester, Pa.
 WARREN B. REED, Edison Electric Co., New Orleans, La.
 HOWARD RINCK, Edison Elec. Ill. Co., Easton, Pa.
 A. L. SMITH, Appleton Edison Elec. Co., Appleton, Wis.
 GEO. R. STETSON, New Bedford Gas & Edison Light Co., New Bedford, Mass.
 N. C. STREYENS, Edison Elec. Ill. Co., Brockton, Mass.
 LUTHER STIRRENGER, Boston Edison Company.
 ADOLPH THEOBALD, Edison Electric Light Co., Columbus, Ohio.
 FRANCIS A. UPTON, General Electric Co., Harrison, N. J.
 J. VAN VLECK, Edison Elec. Ill. Co. of New York.
 D. B. WEEKS, Edison Electric Light and Power Co., Kansas City, Mo.
 CHARLES WIRT, Chicago, Ill.
 W. H. WOPREKAMP, Edison Electric Ill. Co., Lawrence, Mass.
 JOHN WOLFF, Edison Co., Brooklyn, N. Y.

After roll-call Tuesday morning at 10 o'clock the first business was the admission of new members. The following companies were admitted to the Association: Toronto Incandescent Light Co., Toronto, Ont.; Cleveland Electric Illuminating Co., Cleveland, O.; Atlantic City Electric Light Co., of Camden, N. J.; Edison Electric Illuminating Co., of Cincinnati, O.; Edison Electric Illuminating Co., Atlanta, Ga.; U. S. Electric Light Co., of Washington, D. C.; Union Electric Light Co., of Seattle, Wash.

The first business of the meeting was the reading of a report by MR. A. E. KENNELLY, chairman of the Committee on "Lighting Protection, Crosses with High Tension Wires, and on Grounding the Neutral Wire on the Three Wire System." He gave a summary of the experience of Edison stations up to date with these dangers, and made suggestions as to the means of preventing them. The report was accepted and the subjects were considered of sufficient importance to continue the Committee. The Committee's report was followed by a discussion in which Prof. Marks, Mr. Gilbert, Mr. Beggs and Mr. Edgar took part.

PROF. W. D. MARKS then read a paper on "A Board of Control for Central Station Management Composed of the Heads of the Different Departments Making up the Organization."

After discussion on Prof. Marks's paper, the next in order was MR. HALE's paper on "Boiler Testing," giving results of a series of tests made at the new station of the Edison Electric Illuminating Co. of Boston. Before adjournment of the morning session Messrs. Weeks and Field were appointed a committee to nominate officers for another year.

In the afternoon MR. J. VAN VLECK, read his paper on the "Switchboard in the Duane Street Station of the Edison Illuminating Co. New York." Mr. Van Vleck started with a description of the switchboard in its earliest and most primitive forms and ended by giving in contrast the well-worked out plans of the regulating gallery at present being installed in the station at Duane and Elm Sts. An interesting feature of the paper was some account of the "Edgewise" system of metrical instruments developed by the author of the paper.

Following Mr. Van Vleck, MR. PAGE read his paper on "Incandescent Lamps" which was recently presented to the Northwestern Electric Association, and has since been published in connection with the report of that convention. [See THE ELECTRICAL ENGINEER, August 1, 1894.]

MR. BARSTOW, of the Brooklyn Edison Co., then read a paper on the "Low Tension Arc Lighting System," describing the system used by the Brooklyn Company in lighting the central por-

tion of the city from the low tension mains of the Edison Company in a manner never before attempted, this being the first instance in America where street lighting has been attempted from the low tension mains of the Edison underground system. The work had to be developed in all its details, including lamp posts, automatic clocks and other devices. Mr. Barstow presented some data which seemed to indicate to the members present that this form of lighting would be a valuable adjunct to their central station business.

MR. F. PIERCE's paper followed on the "Methods of Electrical Distribution Adopted by the Boston Edison Company." This paper served as an introduction to the visit which the members were to make to the Atlantic avenue station on Thursday.

On the opening of Wednesday morning's session the paper on "Storage Batteries," by Mr. R. R. BOWKER, of the New York Edison Company, to which all of the members of the Association had looked forward with a great deal of interest, was read in Mr. Bowker's absence by Mr. Lieb, of the same company. Mr. Lieb presented also a paper of his own on the same matter. Much discussion arose, both for and against the practical value of the storage battery as an adjunct to central stations. A special committee was appointed by the president to consider and report upon this important subject.

The afternoon session of Wednesday was given up to matters pertaining to the relations of the Illuminating Companies with the General Electric Co., and included an address by Mr. C. A. COFFIN and a paper by one of the General Electric Co.'s engineers, Mr. W. LEROY EMMETT, on "The Relative Advantages of Alternating and Direct Current Apparatus for Central Station Work," which was discussed at great length, especially in respect to the new "Monocyclic System" of the General Electric Co.

The Committee on Officers for the ensuing year brought in the following names in their report, which was unanimously adopted, and the nominees were declared duly elected: Charles L. Edgar, Boston, president; A. L. Smith, Appleton, Wis., vice-president; W. S. Barstow, Brooklyn, N. Y., secretary; J. W. Lieb, Jr., New York, N. Y., treasurer. Executive Committee: John I. Biggs, chairman; C. P. Gilbert, Detroit, Mich.; E. R. Weeks, Kansas City, Mo.; W. D. Marks, Philadelphia, Pa.; E. R. Stetson, New Bedford, Mass.; C. L. Edgar, Boston, ex-officio.

Before the morning session of Wednesday the delegates and others in attendance were given a delightful excursion through some of the beautiful suburbs of Boston. Fine trolley coaches were provided by the Boston Edison Company who gave their guests two hours of keen enjoyment in the bracing early morning air.

Thursday morning was devoted to visits of inspection to the Albany street power house of the West End Railway Company and to the Atlantic Avenue Station of the Boston Edison Company. The trips were made in cars hospitably provided by the West End company.

The afternoon was given to the General Electric Company's works at Lynn. Professor Elihu Thomson both entertained and instructed the visitors by exhibiting a series of interesting experiments with high frequency currents, of which the discharges through water were particularly noteworthy.

The General Electric Company rounded off its entertainment by a late afternoon drive, terminating at Swampscott, and followed, at eight o'clock, by a dinner at the Ocean House. Mr. Coffin presided at table and briefly addressed the company, when coffee and cigars were reached, congratulating the proprietors and managers of lighting plants upon their relative immunity from labor troubles, due he thought to the high average of education and character to be found among electrical employes.

MR. S. DANA GREENE said some cordial words to the representatives of lighting companies present and was followed by Professor Thomson, who briefly outlined the present status of the incandescent lamp in respect to efficiency and life; expressing the opinion that not much further gain was to be expected on present lines; that great gains must and surely would be achieved, but that they must depend upon further and radical discovery or invention.

Half-past ten o'clock brought an enjoyable day to a close.

EXHIBITS.

THE exhibits at the Convention were few in number and were shown in the ante-room adjoining the meeting hall.

THE PETTINGELL-ANDREWS Co. exhibited the Lundell fan and dental outfits.

THE SOLAR ARC LAMP, the latest debutant in the field of arc lamps for incandescent circuits was shown in operation, in charge of Mr. H. W. Weller.

THE GENERAL INCANDESCENT ARC LAMP Co., had on exhibition a full line of their arc lamps and other devices which were in charge of Mr. P. H. Klein, Jr.

THE WESTON "EDGEWISE" INSTRUMENTS, built after the designs of Mr. John Van Vleck, were shown and exhibited admirably their ability to show at the glance the pressure of an entire network of conductors. Mr. Van Vleck was present in person and explained the system to many interested central station men.

LITERATURE.

Official Report of the Frankfort International Electrical Exhibition, 1891. Vol. II. J. D. Sauerlander, Frankfort a. M., 1894. 456 pp. 9x13 inches. Price, \$5.

This is a carefully prepared report and indeed the fact that it has taken about two years and a half to appear after the closing of the Frankfort Exhibition, might well warrant the belief that elaborate care had been bestowed upon its preparation. Its contents are divided into nine sections, as follows:

I. Apparatus for the Production and Transformation of Electricity. II. Electric Lighting. III. Steam Engines. IV. Gas Motors. V. Electro-chemistry. VI. Electro-therapeutics. VII. Telegraphy, Telephony and Signaling. VIII. Electric Railroads and Launches. IX. The Transmission of Energy from Lauffen to Frankfurt.

An international commission of 94 judges, aided by 53 assistants were appointed to examine and test the various electrical exhibits described. The expenses incurred by the commission during the tests appear to have been about \$7,000, of which the largest share was appropriated to the Lauffen-Frankfort tests the cost of which are stated as about \$3,400.

A great deal of important information can be obtained from the study of the tests which are recorded. The observations and measurements for each machine are very fully described and recorded, in many cases with curves and diagrams showing the behavior of the apparatus at various loads and under varied conditions. For example on page 23 diagrams are given representing the behavior of a 600 H. P. Siemens-Halske direct coupled 12-pole (internal pole) continuous current generator. The commercial efficiency of this machine appears to have been 0.8 at $\frac{1}{2}$ load, 0.86 at $\frac{3}{4}$ load and 0.85 at full load, distinctly higher than the corresponding efficiencies for a 600 H. P. Helios generator which are indicated on page 28.

Tests follow of motors, transformers, of the machines that are known to our German cousins by the euphonious word Gleichstromwechselstromtransformatoren, alias rotary transformers for converting alternating into continuous currents, storage batteries, measuring instruments, engines, etc. One criticism presents itself, however. The value of this record to either a general reader or to a competitor in this valuable comparison of machinery, lies not so much in the achievement of any machine alone, as in its achievement relatively to the other machines tested. We should like to have seen the tests tabulated for comparison in such a manner that the relatively salient good qualities of any type or size of machine could be recognized at a glance without having to peruse pages of statistics in order to fairly compare the performances of rival types of apparatus.

It is also to be greatly regretted that, as usual, the prices of the various types of machinery are not mentioned or assessed. It is needless to point out that if two machines will satisfactorily perform the same duty so far as concerns superintendence and freedom from repairs, a relatively higher efficiency of one may be more than offset by a higher cost of construction. We hope that in the future such exhibitions and tests as these will be regarded more as engineering and less as scientific subjects, and that, consequently, the elements of cost of construction will not be omitted.

Throughout the book, a good deal of scattered mathematical demonstration appears, that had much better been left on the pages of the demonstrator's note-book. The diagrams, statements and statistics are valuable enough without infusing demonstrations with which all the esoteric are familiar, and with which the exoteric have nothing to do.

More than one hundred pages are devoted to the Lauffen-Frankfort transmission, which is reported in great detail. The book would be of great value if it contained no other information than the facts recorded in these hundred pages.

It is strange that we do not find among the mass of observations collected under varying loads, conditions, and changes of weather, any observations directly made on the pressure and current at sending and receiving ends of the high tension lines, all observations being apparently confined to the low tension side of the transformers employed.

We have little doubt but that the whole expense incurred in the entire tests of the commission were amply repaid by the results reached from these Lauffen-Frankfort trials, and which are summarized on page 430. It appears that the net efficiency with 7,500 to 8,500 volts triphase transmission varied between 0.685 and 0.725, that the influence of electrostatic capacity in the conductors was not serious, and that in the opinion of the judges such triphase transmission at 8,000 volts to a distance of more than one hundred kilometers, is as simple, safe and sure as ordinary continuous current transmission at a few hundred volts pressure to a distance of a few metres.

There can be no doubt that long after the remembrance of the Frankfort Exhibition shall have died away, the record of its electrical tests and measurements, as given in this volume, will be a valuable compendium for reference.

H. & K.

SOCIETY AND CLUB NOTES.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.

THE following is the preliminary programme of the American Electro-Therapeutic Association which will hold its fourth annual meeting at the New York Academy of Medicine, New York, Sept. 25th, 26th and 27th:—President's Address, Dr. W. J. Herdman, Ann Arbor, Mich., Professor of Diseases of the Mind and Nervous System and Electro-Therapeutist in the University of Michigan.

Reports of the Committees on Scientific Questions.—On Standard Coils, Dr. W. J. Morton, New York. On Standard Meters, Dr. Margaret A. Cleaves, New York. On Standard Electro-Static or Influence Machines, Dr. W. J. Morton, New York. On Constant Current Generators and Controllers, Dr. W. J. Herdman, Ann Arbor, Mich. On Standard Electrodes, Dr. A. Laphorn Smith, Montreal. Stand and Electrode for Static Electricity, Exhibit of same, Dr. Lucy Hall-Brown, Brooklyn, N. Y. On Electric Light as a Therapeutic and Diagnostic Agent, Dr. Margaret A. Cleaves, New York.

The Constant Current.—Physics, Current Distribution, Mr. W. J. Jenks, M. A. I. E. E., New York. Physiological Effects, Prof. A. E. Dole, President Tufts College, Boston, Mass. Therapeutic Uses, General, Dr. A. D. Rockwell, New York; Gynaecology, The Galvanic Current in Catarrhal Affections of the Uterus, Dr. G. Betton Massey, Philadelphia. Suites éloignées du traitement électrique conservateur gynécologique; Grossesses Consecutives, Dr. Georges Apostoli, Paris. Metallic Electrolysis, M. le Docteur Georges Gautier, Paris; Dr. W. J. Morton, New York; Dr. Margaret A. Cleaves, New York; Dr. A. H. Goelet, New York. Treatment of Urethral Stricture, Report to date, Dr. Robt. Newman, New York. Diseases of the Eye, Electro-Therapeutics of, Dr. L. A. W. Alleman, Brooklyn, N. Y. Notes on Goitre and Improvements in Apparatus for Treatment of Same, Dr. Chas. H. Dickson, Toronto. Diseases of the Throat, Dr. D. S. Campbell, Detroit, Mich. The Action of Electricity on the Sympathetic, Dr. A. D. Rockwell, New York. Diseases of the Nervous System, The Treatment of Neuritis by the Galvanic and Faradic Currents, Dr. Landon Carter Gray, New York. Electric Sanitation, Prof. John W. Langley, Ph. D., Case School of Science, Cleveland, Ohio. Physics of the Electric Light in Relation to Organized Matter, Prof. John O. Reed, Ph. M., Asst. Prof. of Physics, University of Michigan. Hydro-Electric Methods, Physics and Appliances, Mr. Newman Lawrence, M. I. E. E., London. Special Hydro-Electric Applications, Dr. Margaret A. Cleaves, New York. The Hydro-Electric Therapeutics of the Constant Current, Dr. W. S. Hedley, Brighton, England.

Induction Currents.—Physiological Effects, Dr. W. J. Engelmann, St. Louis, Mo. Therapeutic Uses, General, General Faradization, Dr. A. D. Rockwell, New York. Gynaecological, Dr. A. H. Goelet, New York; Dr. H. E. Hayd, New York; Dr. A. Laphorn Smith, Montreal.

Sinusoidal Current.—Physics, Mr. A. E. Kennelly, F.R.A.S., Philadelphia. Physiological Effects, Dr. W. J. Herdman, Ann Arbor, Mich.; Dr. J. H. Kellogg, Battle Creek, Mich. Therapeutic Uses, Dr. Margaret A. Cleaves, New York; Dr. Wm. Jas. Morton, New York; Dr. J. H. Kellogg, Battle Creek, Mich.; Dr. Holford Walker, Toronto; Dr. A. H. Goelet, New York. Les Courants Alternatifs, leur transformation, leur mesure et leurs applications thérapeutiques, MM. les Docteurs Gautier et Larat, Paris. On the Sinusoidal Current Methods of Regulation, the E. M. F. and Resultant Current, Dr. Lucy Hall-Brown, Brooklyn, N. Y.

Static and Static Induced.—Physics, Prof. Edwin Houston, Ph. D., Philadelphia. Therapeutic Uses, General Therapeutic Uses, Dr. Wm. Jas. Morton, New York. The Treatment of Chorea, Dr. D. R. Brower, Chicago. Static Induced, Dr. Margaret A. Cleaves, New York. High Frequency Currents derived from Static Machines as per Method d'Arsonval, Dr. J. H. Kellogg, Battle Creek, Mich.

In Memoriam.—Dr. Wm. F. Hutchinson, Providence, R. I., Dr. John Chambers, Indianapolis, Ind., by Dr. Robt. Newman, New York; Dr. Plymon S. Hayes, Chicago, by Dr. W. J. Herdman, Ann Arbor, Mich.

MEETING OF THE A. A. A. S.

THE 48d meeting of the American Association for the Advancement of Science was held in Brooklyn August 16-23. The programme of the meeting made ample provision for both the intellectual and social entertainment of members. While the papers read before the society covered almost every other branch of science, they scarcely touched upon the subject of electricity at all. Two or three short communications, occupying ten minutes each, were listened to in the Physics Section, the most notable of which was one by Benjamin W. Snow, on the "The Directed Velocity of the Particles in the Electric Arc." There was also one by Mary C. Noyer on "The Influence of Heat and Electricity upon Young's Modulus for a Piano Wire."

LETTERS TO THE EDITOR.

PROPERTIES OF ELECTROLYTIC COPPER.

The writer has read with much interest the editorial on "Electrolytic Copper," in your issue of July 4, and the remarks of your correspondent in the *ENGINEER* of July 18 on the alleged mechanical defects in the electrolytic copper employed on a railway feeder. Concerning the properties of electrolytic copper my belief is that your correspondent is entirely mistaken.

There may be some differences in the mechanical and electrical properties of electrolytic and other copper but they are not so obvious as to be perceived in the manner specified. I have tested a large number of samples of copper made by the Bridgeport Copper Co. and the Baltimore Copper Co. and found amongst them some of the best copper electrically that I have ever tested. Electrolytic copper as well as other coppers must be melted into wire bars and it is very easily possible for any copper to be spoiled in the melting process.

It is sometimes stated that copper is not perfectly malleable when it contains less than 5 oz. to the ton of silver but this statement is as yet by no means proven, although electrolytic copper is not likely to contain this amount of silver.

The trouble your correspondent describes is one due to defective rolling and is very commonly found in No. 0000 wire which has been drawn as is very often the case, from half-inch rolled rods. You can readily see that imperfections in rolling can not be taken out in so small a reduction in size. The case he mentions is one not needing an elaborate scientific explanation.

F.

WHERE MR. EDISON LEFT OFF.

In your last issue I noticed that Mr. R. R. Bowker was to read a paper at the Boston convention of the Association of Edison Illuminating Companies, amongst others, on the adaptation of storage batteries to central stations in this country, and while other papers of interest have no doubt been fully discussed at that meeting, would it not be to the point for someone in the Association to inform the public at large what improvements, if any, have been made since T. A. Edison left off inventing for the benefit of the Edison Illuminating Companies? If I remember right, he actually left off, after giving the art the three wire and feeder systems, the high tension lamp (up to 200 volts), and lastly the direct multipolar side commutator generator that he, Kennelly and Henderson evolved a year or so ago.

IN THE DARK.

NEW YORK, Aug. 17, 1894.

PERSONAL.

OXFORD University has conferred the degree of D. C. L., upon Prof. S. P. Langley of the Smithsonian Institution.

THE PACIFIC CABLE.

TENDERS have been called for by the Canadian Government for laying a Pacific cable. Intending bidders must stipulate the cost for the following routes:

First—From Vancouver, B. C., via Necker Island, Fanning Island, Fiji and Norfolk Island, with branches from Norfolk Island to New Zealand and Queensland, in Australia; total distance 7,145 knots.

Second—From Vancouver, via Necker Island, Fiji and Norfolk, with branches to New Zealand and Australia; total distance 7,175 knots.

Third—From Vancouver, via Necker Island, Gilbert Islands, Fiji, New Zealand and the Solomon Islands, to Queensland; total distance 8,264 knots.

Fourth—Via Necker, the Gilbert and Solomon groups (omitting Fiji and New Zealand) to Australia; total distance 6,246 knots.

Fifth—From Vancouver, via Necker and Fiji to New Zealand, total distance 6,127 knots.

Sixth—From Vancouver, via Honolulu (2,280 knots) and Fiji to Norfolk Island, with branches to New Zealand and Australia; total distance 7,078 knots.

Seventh—From Vancouver to Australia, via Honolulu and the Gilbert and Solomon Islands; total distance 8,293 knots.

Eighth—From Vancouver to New Zealand direct, via Fiji, with a middle section, if available; total distance 6,030 knots.

Among other conditions it is stipulated that the cable must be able to transmit at not less than the rate of twelve words a minute. Each offer must describe the character of the cable, its approaches, and cost of building, with provisions for repairs. Contractors are to state the number of steamships required, which, together with the stores, are to remain the contractors' property for three years, when they will be taken over by the Government

at a valuation. Contractors are required to take all risks of landing places for the cable, the Government undertaking to secure landing places at the several points mentioned.

E. P. THOMPSON, M. E.—PROF. W. A. ANTHONY.

MR. E. P. THOMPSON, patent solicitor and expert, of No. 5 Beekman street, New York, has issued a circular announcing that he has associated with himself Prof. W. A. Anthony. Mr. Thompson will give more exclusive attention to soliciting of patents, etc., and Prof. Anthony will have charge of engineering cases.

THE NEW LIVGRO INCANDESCENT LAMP.

In a recent issue of *THE ELECTRICAL ENGINEER* we described the Livgro incandescent lamp, invented by Dr. W. E. Forest, and are now enabled to give the details of its latest form.

The essential feature of the lamp consists in the method of sealing the mount, carrying the leading in wires and filament, into the bulb. In order to avoid the claim of the Edison lamp covering an "all-glass receiver," the Livgro lamp embodies a metallic seal, constituting in effect a stopper lamp.

To carry out this idea the bulb is blown with a short neck having a contraction at the end nearest the bulb. The mount carrying the filament is slipped through the neck and is encircled by a pair of mica washers which fit snugly into the contraction of the neck, mentioned above, forming a temporary seal. The actual sealing of the lamp is effected by pouring into the neck on top of the mica discs a molten metal which does not contract on cooling. On top of this a cement is poured which fills up the remaining portion of the neck and which holds the leading-in wires firmly in place, at the same time insulating them from each other.

Tests made with the Livgro lamp by Dr. L. K. Boehm have, it is claimed, shown it to equal in life, efficiency and candle power the best lamps now on the market.

Owing to the simplicity in manufacture and the absence of fusion by heat the percentage of breakage is exceedingly small and comparatively inexperienced hands are able to turn out an excellent product at correspondingly low cost.

The factory of the company is at Harrison, N. J., and is in charge of Mr. C. F. Whittemore, formerly of the Davis Electric Company.

The officers of the company are: J. Livingston, president; Albert H. Gross, secretary and treasurer. The executive offices are located at No. 50 Broadway and the salesrooms in the Cable Building, corner of Houston street and Broadway.

THE MATHER ELECTRIC CO.'S WORKS.

THE plant of The Mather Electric Company, covering a number of acres, is situated in Manchester, Connecticut (three hours on the train from either New York or Boston), directly on the main line of the New York & New England Railroad, which, together with a spur track running directly into their erecting shop, allows them to load heavy generators directly on the cars and gives them the best of facilities. They have recently completed an extension to their plant in the form of an iron building 300 x 50 feet, for an erecting shop, constructed by the well-known Berlin Iron Bridge Company of East Berlin, Conn., and fitted with a fifty-ton Shaw electric traveling crane, which, together with a large amount of new machinery which The Mather Company have recently installed, consisting of heavy planers, boring mills, radial drills, lathes, etc., enables them to handle large generators up to 500 kilowatts, and larger, in capacity.

The Mather Electric Company are making a specialty of both belted and direct connected work, especially for railway and power purposes. Their facilities for testing generators, from the smallest to the largest, under most severe conditions, are second to none, their steam plant being especially arranged and adapted for this purpose. The Mather Company already contemplate another extensive addition to their plant, in the early future, to accommodate large work and a new battery of boilers and engines, especially for testing this class of apparatus. The entire plant of The Mather Company is operated by electric motors, varying in size from five to fifty horse power, which system of transmission and sub-division of power they have found exceedingly satisfactory and economical in the operation of their works.

THE GERMANIA LAMP FACTORY.

It is reported, says the *Marlboro, Mass., Times*, that the Bryan-Marsh Co., manufacturers of electric incandescent lamps in the Germania factory, having been enjoined from the further manufacture of incandescent lamps, has gone out of the business. It is to be succeeded, however, very soon, by the Marlboro Electric and Machine Co., who will continue the business.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS
ISSUED AUGUST 14, 1894.**Accumulators:—**

Electrical Storage Battery, B. C. Van Enon, San Francisco, Cal., 524,656. Filed Nov. 6, 1893.

Provides means for protecting the inner face and the edges of the section of active material from the electrolyte and enclosing the active material in an elastic, indestructible grid.

Alarms and Signals:—

Battery Changer for Electric Circuits, C. Bernhardt, Chicago, Ill., 524,374. Filed Nov. 23, 1891.

Has for its object to bring into a fire alarm circuit a fresh battery at the moment when certain parts of the system come into operation, and to cut out of circuit the ordinary battery.

Automatic Electric Signaling Device, E. A. Hermann, St. Louis, Mo., 524,548. Filed April 16, 1894.

A semaphore system for electric railways operated by an overhead circuit.

Conductors, Conduits and Insulators:—

Electrical Conductor, E. D. McCracken, Alpine, N. J., 524,248. Filed Nov. 29, 1893.

Employs a covering of strips of vegetable fibre, coated to render it anhydrous.

Insulator, G. H. Winslow, Pittsburg, Pa., 524,659. Filed Dec. 8, 1893.

Claim 1 follows:—

An insulating body, an oil cup coöperating, and means for supporting said oil cup directly from said insulating body.

Distribution:—

System of Electrical Distribution, T. A. Edison, Llewellyn Park, N. J., 524,378. Filed Dec. 6, 1893.

Employs two feeding circuits from a high tension generator, each including the primary coils of a reducing converter, translating devices in multiple series, a conductor from the secondary of one converter to the translation circuit, a conductor from the secondary of the converter to the other feeding circuit and also to the translation circuit, a conductor from between the translating devices to the one joining the secondaries, and means for separately regulating the two feeding circuits.

System of Power Distribution and Regulation, J. W. Gibboney, Lynn, Mass., 524,381. Filed Oct. 21, 1893.

Consists of two or more independently operated plants with a dynamo at each adapted to coöperate, and an electric circuit connecting the machines in parallel.

Dynamos and Motors:—

Regulation for Dynamo Electric Machinery, E. M. Bentley, Boston, Mass., 524,373. Filed Dec. 26, 1890.

The method consists in varying the counter electromotive force by simultaneously varying the field magnet strength and including a greater or less number of active armature coils in series.

Compounding Motor Generators, J. Burke, Schenectady, N. Y., 524,376. Filed June 5, 1894.

Employs a motor generator having its armature motor winding in series in the primary circuit and its field magnets in shunt to the motor winding, and an auxiliary counter electromotive force machine whose armature is distinct from that of the main machine and in series with the primary circuit, and its field magnets having a winding in shunt to its armature and a differential series winding in the secondary circuit.

Controller for Electric Motors, J. H. Jenkins, Lynn, Mass., 524,385. Filed Feb. 8, 1894.

Comprises an actuating shaft carrying a circuit modifying device, and means for removing the latter from the shaft without removing the shaft from its bearing.

Controller for Electric Motors, W. B. Potter, Lynn, Mass., 524,396. Filed Dec. 21, 1893.

Employs a switch with a number of contacts, and a blowout magnet having a common pole piece extending from a common core to points adjacent to the several circuit breaking points of the switch.

Electric Motor, W. L. Silvey, Dayton, Ohio, 524,407. Filed March 2, 1894.

Employs a field magnet consisting of two wire wound electromagnetic rings having pole pieces of alternate polarity projecting from their sides between the coils.

Electromagnetic Motor, N. Tesla, New York, 524,426. Filed Oct. 20, 1893.

Claim 1 follows:—

In an alternating current motor the combination with energizing coils adapted to be connected with an external circuit of cores of different magnetic susceptibility so as to exhibit differences of magnetic phase under the influence of an energizing current.

Dynamo Electric Machine or Electric Motor, A. B. See & W. L. Tyler, Brooklyn, N. Y., 524,532. Filed May 10, 1894.

Claim 2 follows:—

A dynamo electric machine or electric motor having its brushes mounted upon elastically yielding supports and insulated therefrom, and flexible conductors leading from the brushes.

Alternating Current Motor, W. Stanley, Jr., Pittsfield, Mass., 524,534. Filed April 12, 1893.

Consists of independent sets of poles energized by alternating currents of different phase, in combination with an armature and coils thereon within the influence of the field; the coils on one field being closed through coils in the other field displaced with reference to the first.

Pneumatic Controller, E. H. Dawson, Jr., Lynn, Mass., 524,541. Filed April 11, 1893.

Adapted especially for use in connection with reciprocating electric locomotives.

Pneumatic Controller, E. H. Dawson, Jr., Lynn, Mass., 524,542. Filed July 13, 1893.

Similar to 524,541.

Motor Regulator, J. F. Sheahan, New York, 524,515. Filed May 28, 1894.

Employs a single rheostat arranged in the motor circuit and adapted to be automatically operated by means of a weighted arm.

Heating:—

Electric Heater, C. H. Newbury, St. Paul, Minn., 524,646. Filed Apl. 19, 1894.

The invention consists in means for supporting the resistance wire in an electric heater.

Lamps and Apparatus:—

Arc Lamp Post, R. R. Bowker, New York, 524,305. Filed June 22, 1894.

Electric Arc Lamp, O. H. Swoboda, New York, 524,357. Filed July 19, 1893.

Employs a shunt around the arc for energizing a magnet, between which and the feed mechanism means are interposed for impacting the energy of the magnet to the feed mechanism when the arc is broken.

Electric Search Light, E. R. Knowles, Middletown, Conn., 524,388. Filed Jan. 9, 1893.

Claim 1 follows:—

In a search light, the combination with the drum, of a diverging lens, and an electric motor supported on the drum, and moving therewith and arranged to operate the lens.

Arc Lamp, R. Drysdale, Everett, Mass., 524,462. Filed Jan. 14, 1893.

Relates to certain details of the feeding mechanism.

Miscellaneous:—

Method and Apparatus for Detecting and Measuring Inflammable Gases, B. O. Tilghman, Jr., 524,361. Filed Mch. 14, 1893.

Insulating Turn Buckle, H. H. Luscomb, Hartford, Conn., 524,467. Filed June 5, 1894.

Induction Coil, C. L. Jaeger, Maywood, N. J., 524,686. Filed Jan. 18, 1894.

Claim 1 follows:—

The combination with an induction coil, having connections with two separate generators of electricity, of a device for automatically switching in the auxiliary generator on the failure of the primary generator.

Electric Belt, F. A. Brewster, Baltimore, Md., 524,664. Filed June 2, 1894.

Insulating Turnbuckle, L. McCarthy, Boston, Mass., 524,634. Filed June 13, 1894.

Railways and Appliances:—

Electric Railway System, T. B. & H. Wilcox, Newark, N. J., 524,366. Filed Aug. 1, 1893.

Employs a surface plate enclosed in a box in which a magnetic contact maker reciprocates, in combination with a magnet operating outside the plate for causing the reciprocation; the exposed portion of the plate consisting respectively of magnetic and non-magnetic parts insulated from one another.

Electromagnetic Contact Making Device for Electric Railway Systems, T. B. & H. Wilcox, Newark, N. J., 524,367. Filed Aug. 1, 1893.

Consists of an electromagnet enclosed in a casing and resting upon an annular ring of soft rubber.

Electric Railway System, T. B. & H. Wilcox, Newark, N. J., 524,368. Filed Aug. 16, 1893.

Employs a series of exposed contact plates along the track operating in connection with electromagnets carried by the car.

Trolley Wire Switch, J. M. Anderson, Boston, Mass., 524,672. Filed Apl. 26, 1894.

Switches and Out-Outs:—

Rheostat, A. B. Herrick, Schenectady, N. Y., 524,382. Filed May 22, 1893.

Claim 1 follows:—

In a rheostat a fuse included in the circuit, of current-carrying capacity greater than that of the resistance wire and adapted to break the circuit when the heat of the box is excessive.

Bus Bar Switch for Central Stations, A. B. Herrick, Schenectady, N. Y., 524,383. Filed June 9, 1894.

Claim 1 follows:—

A system of bus bar switches for a central station comprising bus bars, switches adapted to connect the bus bars in different combinations, switchboards located in a gallery, and mechanical connections between the switches on the bus bars and the apparatus located upon the switch-board in the gallery.

Double Throw Snap Switch, E. M. Hewlett, Schenectady, N. Y., 524,394. Filed July 2, 1894.

A double throw snap action knife-blade switch, comprising a central blade and spring actuated outer blade pivoted thereto.

Automatic Circuit Breaker, A. C. Carles, Portland, Me., 524,630. Filed April 14, 1894.

Adapted to open the circuit of an overhead railway conductor or the like in case of the wire breaking and falling into the street.

Telegraph:—

Telegraphic Transmitter, F. F. Howe, Marietta, Ohio, 524,633. Filed Jan. 15, 1894.

Telephones and Apparatus:—

Telephone Switch, H. T. Johnson, Elizabeth, N. J., 524,387. Filed Feb. 1, 1894.

Employs a circuit controlling device for breaking the circuit through the signaling apparatus and establishing it through the telephone; a local circuit for actuating the controlling device, and a switch for the local circuit.

Telephonic System, H. A. Chase, Boston, Mass., 524,480. Filed April 16, 1894.

Employs a circuit controller governing the transmitter circuit and a movable shield co-operating with the mouth-piece of the transmitter and operatively connected to the circuit-controller.

Telephone Transmitter and Resistance Varying Material Therefor, F. B. Colvin, New York, 524,524. Filed Oct. 10, 1893.

Claim 4 follows:—

A telephonic electrode made from the carbon residuum of an oil.

FAILURE OF T. W. NESS & CO.

T. W. Ness & Co., electrical supply dealers, Montreal, have assigned on demand of B. & S. H. Thompson, liabilities about \$40,000. Principal creditors, Interior Conduit and Ins. Co., New York, \$499; B. & S. H. Thompson, \$5,100; E. F. Phillips Electrical Works, \$550; Bishop Gutta Percha Company, New York, \$2,019; Consolidated Electric Storage Co., Boston, \$695; Bundy Manufacturing Co., Binghamton, N. Y., \$1,021; R. B. Angus, \$600; Reliance Electric Manufacturing Co., Waterford, Ont., \$1,150; Canadian General Electric Company, Toronto, \$604; Holtzer Cabot Electric Co., Boston, \$531; W. T. Ness, Boston, \$1,557; James Ness, King, Ont., \$3,263; David Spence, Brantford, Ont., \$500; Merchants Bank of Canada (indirect—partly secured), \$13,000. No statement of assets has been given out, but it is hoped they will make a good showing.

NIAGARA'S POWER FOR CANADA.

THE power plant on the Canadian side of Niagara Falls has been begun by the Canadian Niagara Falls Power Company. It will be similar to that on the American side, and have three turbines, with provision for three more.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE STRONG RETURN TUBULAR INTERNALLY FIRED BOILERS.

THE accompanying illustration represents a 2,000 H. P. battery of Strong's return tubular internally fired boilers recently erected at the Ridgewood Pumping Station, Brooklyn, N. Y., Water Works. According to the contract specifications each of these boilers was to be capable of developing 800 H. P. under natural draft and 500 H. P. under forced draft, allowing 20 pounds of water per horse power.

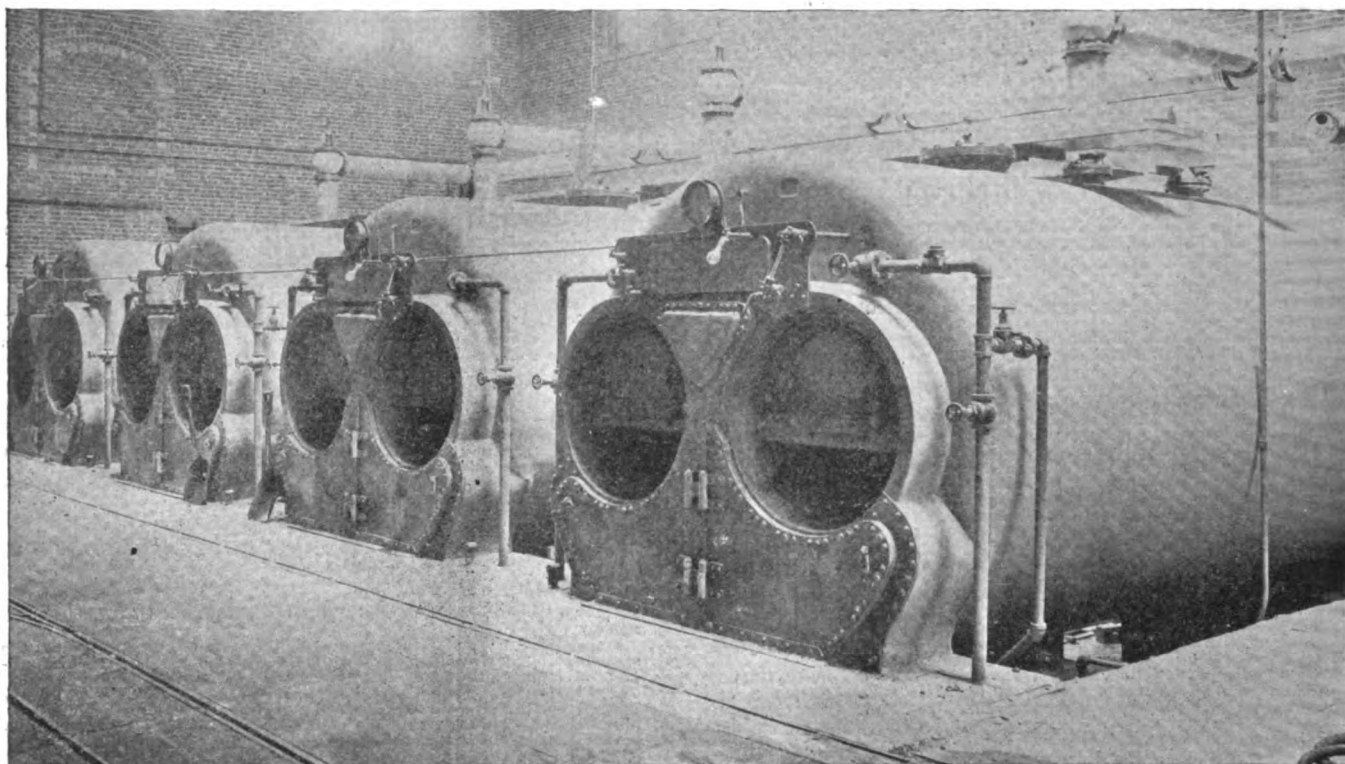
This plant was designed to meet what was considered to be a high duty or guaranteed requirement, i. e., 10 pounds of water per pound of anthracite coal from a temperature of 212° F. to dry steam of 110 pounds above atmospheric pressure, each boiler to have a capacity of 6,000 pounds of water per hour, and to be capable of evaporating 10,000 pounds of water under forced draught without loss of efficiency or making wet steam and without priming.

The designer of these boilers having had considerable experi-

ing loose at the place where the flue connection is made, and no leakage of air into the flue can take place.

The boilers are covered with 8 inches of asbestos cement, 1" air space, so that very little heat is radiated and the boiler room is comfortably cool in warm weather; while in winter, with no other means of heating, a man would find it necessary to go fully clothed or to work to keep warm; thus the large loss of heat usual to brick set boilers and especially that due to air leakage is avoided.

Circulating plates are also arranged on either side reaching from a point near the water line to a point near the bottom of the boiler, so that the water gets back to the bottom of the boiler without obstruction. The water then starts up through the tube-chamber around the tubes, and then around and between the furnaces, which, being the hottest, generate the most steam, and then it is thrown off at the water line, and as only 20 per cent. of the evaporation is done around the tubes, no priming or lifting of the water can take place. As there is a very large amount of direct heating surface, every foot of which is claimed to be worth ten feet of tube surface, the boiler is capable of giving a very great capacity for a given number of square feet of heating surface. It has been found very good economy to get a high rate of combustion per square foot of grate surface, better results being obtained with 20 pounds of coal per square foot of grate than where only 10 to 12 pounds are burned, and, as above pointed out,



BATTERY OF 2,000 H. P. STRONG RETURN TUBULAR INTERNALLY FIRED BOILERS, RIDGEWOOD, BROOKLYN, N. Y.

ence with high rates of evaporation on locomotive types of boilers and internally fired boilers, realized that the largest per cent. of the steam (80 per cent.) would be generated around the furnaces, and that to prevent priming when the boilers are forced this 80 per cent. of the steam should not be forced through the tube chamber around the tubes, as by so doing it would carry the water that should remain solid and in contact with the tubes away from the tubes and cause priming. So it was deemed best to locate the furnaces near the water line and place the tubes below the furnaces, thus allowing the steam thrown off by the furnaces to pass at once to the water line while hot and partially superheated. The gases pass from the ends of the furnaces, which are 18 feet long, into a brick-lined chamber at the back of the boilers, which chamber is part of the shell and entirely air tight so that no leakage of air can occur. This back or combustion chamber is provided at the bottom with a hopper with a slide, to receive any ashes that would otherwise be drawn into the tubes. The gases drop from the end of the furnaces into the tubes, through which they return to the front and drop into an underground flue or tunnel which leads to the stack located outside of the boiler house. There is a damper on the downtake of each boiler, and a large one in the main flue just inside the wall of the boiler room, which latter damper is controlled by an automatic regulator.

The boilers are supported on a pier at the front, where they are built into the flue, and at the back are carried on a rocker with a safety pier, allowing them to contract and expand without break-

ing no damage can occur.

Following are the data of the tests of three of these boilers, made at Ridgewood, by Mr. L. Russell Clapp, Assistant Engineer, before acceptance of the plant.

BOILER DATA.

Average steam pressure lbs.	107.50	109.48	109.44
" barometric pressure, lbs.	14.758	14.734	14.680
Weight 1 cubic foot feed water, lbs.	61.581	60.846	60.679
Dryness of steam, taken at engine.	.992	.989	.997
Feed water through cylinders, lbs.	50,601	157,014	50,717
" " " jackets, lbs.	8,542	7,851	8,550
Total feed water	54,143	164,865	54,267
Percentage of jacket water	7	5*	7
Total coal used, lbs.	5,280	16,026	5,120
Percentage of ash	9	9	9
Net combustible	4,806	14,584	4,659

* NOTE—Two per cent. of jacket water lost by defective drain pipe.

WORK OF BOILERS.

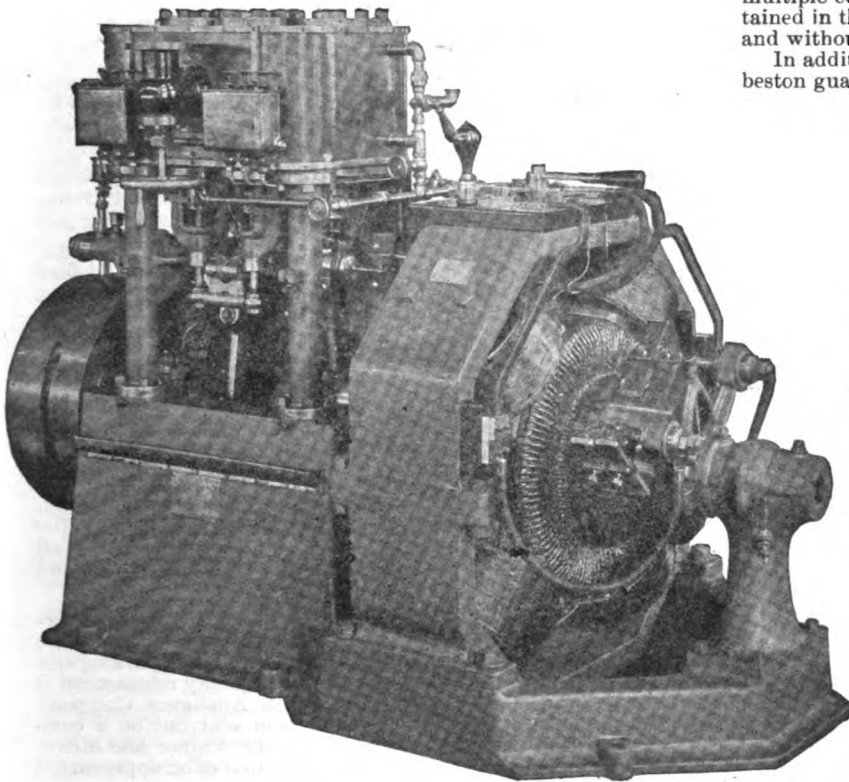
	lbs.	lbs.	lbs.
Evaporation (actual conditions) per lb. coal.	10.13	10.34	10.60
Evaporation from and at 212°	11.33	11.22	11.43
Evaporation combustible from and at 212°	12.46	12.33	12.56

These boilers, we may add, were manufactured by the Edge Moor Iron Co., of Wilmington, Del., from designs of Mr. Geo. S. Strong, of No. 1 Broadway, New York, who is the representative of the Edge Moor Iron Co. for its sale.

GENERAL ELECTRIC MARINE LIGHTING COMBINATION.

The illumination of vessels by electricity instead of oil lamps has so rapidly extended that it may be said there is hardly a steamship of any importance which is not equipped with an electric lighting plant. This is partly due to the example set on land, but mainly to the fact that the apparatus to fulfill the requirements of marine service and cope with the conditions which obtain on board ship, has reached a high degree of perfection. The accompanying illustration shows a small marine generating plant which is demonstrative of this fact and which has recently been placed on the market by the General Electric Company.

The engine of the combination is of the automatic cut-off type, double and vertical, and is rated on a basis of 80 pounds initial steam pressure one-quarter cut-off. This leaves a liberal reserve capacity above the rating given, and the engine can be run under any steam pressure between 60 and 100 pounds. All the parts are accurately cut, so that in case of necessary repairs delay in fitting is avoided. All bearing surfaces are carefully fitted and flat surfaces scraped to surface plates. The crank shaft is of hammered Bessemer steel made in one piece, while the connecting rod is of forged steel with babbitted boxes. The cross head is of a crucible



GENERAL ELECTRIC MARINE LIGHTING COMBINATION.

steel casting with babbitted wearing surfaces and the main bearings are provided with interchangeable babbitted cast iron boxes, and are of extra length.

The dynamo is well protected with oil guards and guards are furnished for all places where oil is liable to be thrown. The oiling arrangement is such that the engine may be run continuously without stop, and the bed is so constructed that all the waste oil is collected in one pit from which it may be drawn, strained and again used. The governor is of very simple construction, its parts are readily accessible and are always in sight. All those parts of the combination subject to wear are made of hardened tool steel.

The variation in speed from extreme light load to the full capacity of the dynamo does not exceed four per cent., and full load may be thrown on or off with not more than four per cent. increase or decrease in the speed. The connection between the engine and dynamo is made through a solid flange coupling especially constructed for ready and easy disconnection of the armature. The latter is of the smooth body type and the entire load may be thrown on without shifting the brushes and without sparking. The sets are built in four sizes, 15, 30, 40 and 50 kw.

These combinations while primarily intended for marine work, are also especially adapted for isolated plants in hotels, theatres, office buildings, etc., and all the qualities which characterize them will be found equally advantageous whether the plant be on land or sea.

THE EXCELSIOR ELECTRIC CO'S. WORLD'S FAIR AWARD.

The award granted to the Excelsior Electric Co. by the World's Fair specifies the following as the characteristics of the machine:

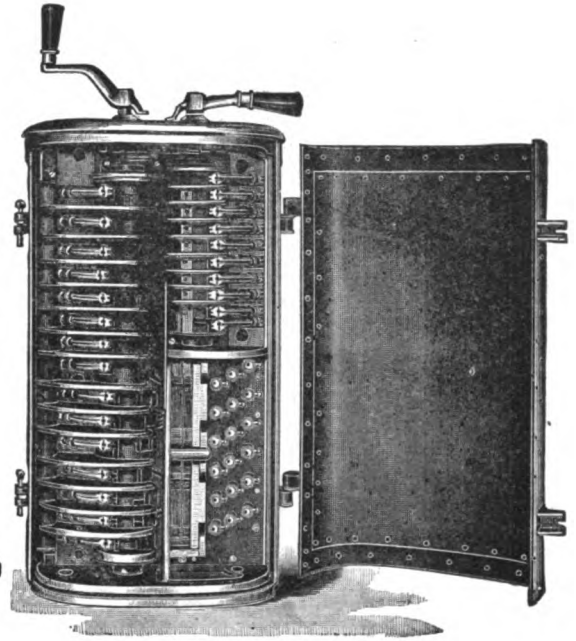
1. Efficient mechanical and electrical design.
2. Ease of removal and replacement of parts.
3. Good regulation, and satisfactory general operation.

It may be added that throughout the entire duration of the exhibition not a single interruption or trouble of any kind whatever was recorded against the Excelsior machines employed in the lighting of the World's Fair—a most remarkable record.

THE NEW "STEEL" RAILWAY MOTOR CONTROLLER.

In our issue of last week, we described the new "Type C" motor made by the Steel Motor Company, of Cleveland, Ohio. The accompanying illustration shows the type "C" controller, used with that equipment. It is designed to have all the advantages of existing types of series parallel controllers, is simple, and provided with a device whereby a single motion of the reversing lever to a point indicated, makes it a straight multiple controller. In connection with the double fuse box contained in the controller either motor can be cut out in an instant, and without leaving the platform.

In addition to the regular discs separating the contacts, vulcanite guards are inserted between them, effectually preventing



NEW "STEEL" RAILWAY MOTOR CONTROLLER.

an arc from forming. These guards are hinged at the side of the controller, so as to be readily thrown back when the jacket is opened. The resistance coil used in starting the car gradually is simple in construction, entirely protected from water, and practically indestructible in ordinary service. A unique feature of this equipment is the substitution of a very simple and inexpensive device for the cutting out of the loop in the field when the highest speed is desired; the device is isolated from the motor proper, and so arranged in connection with the field that most of the danger of the field burning out by an overcharge of current is eliminated.

COLUMBIA ELECTRIC CO.

The Columbia Electric Co., of Worcester, Mass., has issued a folder calling attention to some of the work it is now doing and is prepared to do. The Columbia dynamo is meeting with great success, and the company has installed many complete plants which are giving excellent satisfaction. The supply department contains a large and varied assortment of electric light and railway specialties, and the department of tests and plans is under the charge of electricians of experience, while the factory is equipped with modern machinery of every description.

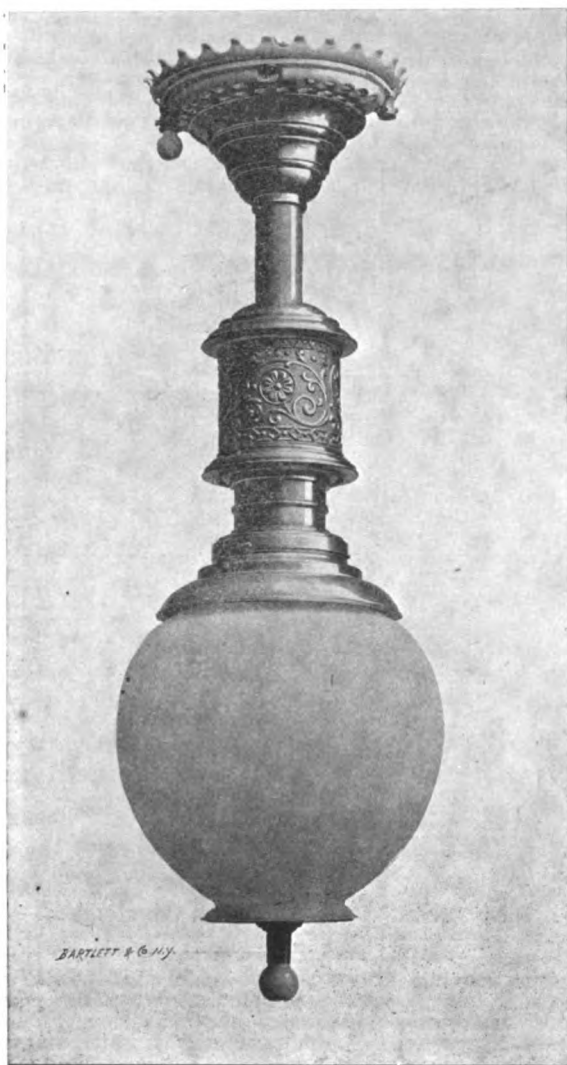
The company's offices are in the Burnside Building, Worcester, Mass.

THE MANHATTAN INCANDESCENT ARC LAMP.

THE accompanying illustration shows the Manhattan incandescent arc lamp, manufactured by the Manhattan General Construction Company, of 50 Broadway. It is a radical departure from existing types, and is claimed to embody a maximum of good points with a minimum of drawbacks. The mechanism is all concentric to the central stem; magnet, armature, clutch mechanism, cut-out, carbon-holding frame and globes.

In the outside lamps the main-line circuit runs through a switch in the cap, and the lamp may be removed and the circuit left to pass uninterrupted. The wires enter the cap through inclined insulated openings which exclude the weather.

To shorten the lamp, the customary carbon rod has been dispensed with and a thin sheath or holder feeding through the clutch rings with the bare carbons substituted. A cushioned clutch feed is provided which gives a perfectly smooth and imperceptible feed, without the characteristic jumps of some lamps.



MANHATTAN INCANDESCENT ARC LAMP.

The most important feature of the lamp is the enclosed globes. The outer globe is air tight at all points except at the bottom, where there is a hand-hole large enough to admit of cleaning and trimming the lamp. This hand-hole is yielding closed by a detachable dustpan. The upper opening of the outer globe is secured to the carbon frame and there made air tight by asbestos gaskets, the globes and frame screwing into the body of the lamp.

Within this enclosing globe, and immediately surrounding the arc, is a smaller globe into which the carbons are fed, there being, however, no air-tight bearings. The inside globe acts as a chamber of high rarefaction, while the outer globe is a storage for the products of combustion, or diluting chamber, thus preventing access of air containing oxygen to the carbon points. On the formation of an arc, the enclosed air is heated and rarefied, the surplus air escaping through the lower vent. The contained oxygen is soon reduced by combustion with the carbon points to car-

bon monoxide, and this, with the remaining nitrogen, surrounds the arc and protects the points from further combustion.

By this system of burning of carbons in these enclosed chambers, half-inch carbons will burn eighty hours without retrimming, and without any blackening or discoloration of the globe. Owing to the high potential at which it is possible to burn the arc in this enclosing chamber, the efficiency of the lamp is greatly increased.

The lower part of the carbon frame is in the shape of a ring having diametrical enlargement to admit the arms of a spider-shaped casting, and which is provided with an adjustable movement on the carbon holder. This carbon holder has a porcelain handle and a spring to hold the yielding pan tightly against the lower opening of the globe. A longitudinal bore in the carbon holder admits the negative carbon, the upper part of the bore being enlarged to form a seat for the small globe. A metal cover, through which the positive carbon loosely feeds, is placed over the mouth of the small globe and acts as a cut-out when the carbon has been burned to a predetermined point.

For the inside lamps a rheostat of enameled iron is provided in shape of a head-board with binding posts, hanging straps and switch complete. An opening in the centre of the rheostat admits of securing it to the ceiling by half-inch lag screws. Porcelain insulators, placed over four studs provided for that purpose, may be used to separate the rheostat from contact with the ceiling. When not desirable to secure the rheostat directly to ceiling, the lamp may be suspended from a ring.

WESTERN NOTES.

THE WALLACE ELECTRIC COMPANY, Chicago, are about to add a complete line of arc lamps for direct and alternating currents to their already extensive stock of specialties.

THE ACME FILTER COMPANY, St. Louis, Mo., are sending out an attractive circular describing their celebrated oil filter and giving a partial list of the numerous users of the device.

THE HYDE PARK ELECTRIC LIGHT AND POWER CO., Chicago, has secured an injunction protecting its wires at State and 61st streets from interference by the city. The city claimed that the Hyde Park Co. had no right to furnish power outside of the town of Hyde Park.

MR. GEORGE W. CONOVER, Western agent for the Perkins Electric Co., reports a growing demand for the Waterhouse arc lamps for incandescent circuits. The lamps, he reports, have recently been improved, making them especially suitable for use on railway circuits.

THE ERIE CITY IRON WORKS, through their Chicago office have recently closed some important contracts for boilers and engines. This company have recently secured the right to manufacture the Laughlin water tube boiler, which is claimed to combine all desirable qualities with none of the defects or disadvantages found in steam generators of that class.

THE ELECTRIC APPLIANCE COMPANY are meeting with wonderful success in the introduction of the Arnold Magneto Telephone for which they are general selling agents. The loud-speaking and clear articulating qualities of the instrument easily recommend it to intending purchasers and the Electric Appliance Company state that when the instruments have been sent out on a competitive test they have always come out the winner and instruments sent out subject to satisfactory operation or on approval are always a sure sale.

THE SIEMENS & HALSKE COMPANY, Chicago, as announced in our last issue, have leased the plant of the Grant Locomotive Works at Cicero and are already at work filling important contracts, the completion of which was delayed by the recent burning of their works. It is not at all improbable that an entirely new concern, embodying the interests of the Siemens & Halske Company, the Wells-French Car Company and the Grant Locomotive Works will be formed under the name of the Siemens Company, with a capital stock of \$2,000,000.

NEW YORK NOTES.

MR. E. J. WESSELS, general manager of the Gennett Air Brake Co., of 33 Wall street, has closed contracts with the Athol, Mass., Lowell, Lawrence and Haverhill, Mass., Newport, R. I., New Haven, Conn., and Easton, Pa., railways for air brake equipments, and is having numerous inquiries from abroad. Mr. Wessels reports that the brake is doing splendidly, and that, in no case where it has been used, has there been an accident due to its failure to work.

Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.

Vol. XVIII.

AUGUST 29, 1894.

No. 330.

RECENT OBSERVATIONS ON EARTH CURRENTS.

BY

THE working of telegraph lines extending in an easterly and westerly direction was greatly affected by the magnetic storm of Aug. 19 and 20 which was accompanied by displays of brilliant auroræ observed in various sections of the country. The disturbance was first observed about 9 P. M. on Sunday Aug. 19, when the wires began to work badly, and become so intense at frequent intervals throughout the night as to render circuits useless, not only on land lines but on submarine wires as well. The storm, which exhibited many of the ordinary characteristics of such phenomena, did not finally disappear until after 5 P. M., Monday, Aug. 20, though its effects after 9 o'clock on the morning of that day were not very marked east of Chicago; but they were sufficiently pronounced on lines west of that point to cause temporary stoppage of work, especially on automatic and quadruplex circuits.

Similar phenomena were noted on July 20, and the disturbance which was first felt about 5.20 A. M., assumed a wave-like character which reached its highest altitude with almost perfect regularity about once every two hours until 7.30 P. M., when the storm so far subsided as to leave the working of land lines unaffected.

The ebb and flow of the earth currents during the prevalence of the storm were generally characterized with remarkable steadiness and deliberation, forming a strong contrast to the violent fluctuations of many preceding magnetic storms, one of which exhibited no fewer than 150 variations in the magnitude and polarity of its currents in the course of a single minute. An interesting practical point in this connection consists in the fact that whereas land lines are invariably influenced by either of these classes of earth current, provided the latter is sufficiently strong, the submarine cables do not seriously feel the effects of a very gradual variation of current.

It frequently happens that the Atlantic and other cables enjoy comparative immunity from earth current interruptions at times when land lines are more or less prostrated; while at other times the cable circuits have suffered from comparatively weak but fluctuating currents that had no practical influence upon the working of aerial wires. This anomalous action arises from the fact that condensers are interposed in cable circuits, which are operated, not by continuous currents as in the case of land lines, but by induced currents of momentary duration produced by the charging and discharging of the condensers. The latter being responsive only to sudden variations in current strength, it will be evident that such apparatus serves to exclude from the cables all but the more variable class of currents, which latter, however, affect the cable irrespective of the current value.

The storm of July 20 did not apparently pursue the usual easterly and westerly direction, but took a course more nearly N. N. W. judging from the results of a number of simultaneous observations taken on different wires with the view of determining the line of maximum disturbance. The greatest difference of potential discovered on any wire on that occasion was 62 volts, but from indications noted at times when it was found impracticable to take scientific measurements, it was evident that the electromotive force developed in some circuits amounted to upwards of 150 volts.

From the result of other tests, the writer was able to practically demonstrate that the difference of potential established between the ends of any wire is directly proportional to the *geographical* length of its circuit; or in other words, the electrical pressure developed is not determined by the actual course taken by the wires, but by that of a straight line, drawn from one extremity or ground connection to the other.

This statement, which might otherwise appear so self-evident as to be superfluous, is intended to emphasize the fact that the distance between any two points on the earth's surface is so small compared with the distance between the sun and earth, that the law of inverse squares as ordinarily applied to electric forces is practically reduced to one in which the E. M. F. developed in any conductor is directly proportional to the shortest distance between its terminals.

Sun spots are generally credited with being the cause of earth currents, and it is a fact within the writer's knowledge and experience that no magnetic storm of any magnitude has ever appeared without its accompanying solar disturbance; but it is equally a fact that the two phenomena are not invariably associated with each other, inasmuch as groups of prominent sun spots have oftentimes been visible upon the sun's disc when earth currents have been conspicuous by their absence.

This circumstance would appear to confirm the views held by Dr. M. A. Veeder who has made a study of the subject, and who is in possession of data which apparently prove that magnetic storms are only possible when the spots are in a particular locality and when the earth occupies a certain position in relation to those spots.

He further contends that the effects produced are brought about by *conduction* rather than by *induction*, and that the masses of matter thrown off from the sun when the latter is violently agitated, constitute the medium through which the electrical energy is transmitted from the sun to the earth, as otherwise the presence of earth currents ought to be felt whenever and wherever sun spots are visible, if the latter are to be regarded as the direct cause of terrestrial magnetic phenomena.

The subject is one of considerable scientific interest, and is at present engaging the attention of scientists throughout the civilized world, a great number of whom are in direct communication with Dr. Veeder on the subject. Through the courtesy of General Eckert, President and General Manager of the Western Union Telegraph Co., observations are now being taken on that company's lines which it is hoped will be of service in aiding such investigations.

HEATING BY HOT WIRE RESISTANCE.

BY

Austin S. Latch

In heating by any method the first question presenting itself is, the expansion of air for different temperatures and consequently the relative spaces required for the cold and heated air. The second question is, what will be the

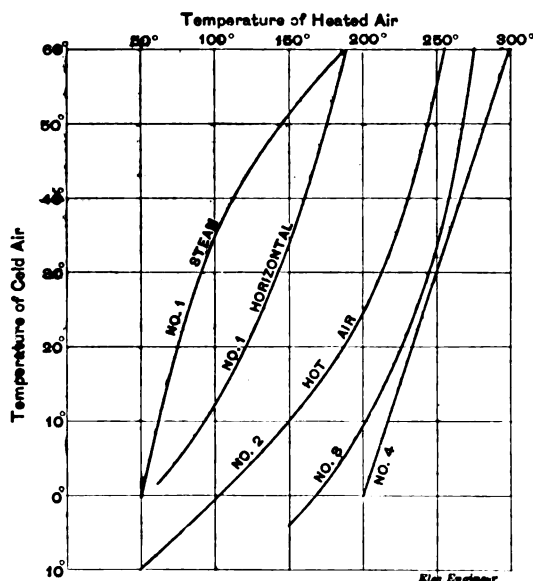


DIAGRAM SHOWING HEATING BY HOT WIRE RESISTANCE.

temperature of air passing over a heated body of a given temperature, and consequently its velocity?

Of course the first depends on the result of the second. The accompanying diagram shows the temperature measured under the varying conditions. The temperature was taken with the thermometer held one foot above the heater. Curve No. 1 is produced from a steam coil. Curve 2 is the temperature of air on a horizontal coil heater without any regulation to the ingress of the air. No. 3 is from a heater supplied with dampers. No. 4 is the ideal line and would be secured by keeping the velocity of air constant, which is 17.1 feet per second. The double curve of No. 1 is caused by a vertical and horizontal coil, respectively. Curve 2 is from an electric coil with top and bottom open made by stretching wires between two parallel boards. Curve 3 is from a heater with dampers to cold air inlet. The same number of watt hours were used in both curves 2 and 3.

With these curves as a guide I built two electric heaters requiring $1\frac{1}{2}$ amperes at 500 volts, placing them in an electric car at Windsor, Ont. I finally placed heaters in all the cars there, two of which ran 18 hours per day, and the following is the readings from one of them:

Temperature outside.	Temperature inside. Lowest.	Watt-hours used during 18 hours run.
8° to 10°	48°	16,085
11° to 14° (windy)	47°	16,324
-3° to 6°	41°	21,246
21° to 25°	60°	18,004

This is not the record of the two 750 watt heaters but of four 500 watt heaters placed in one car. It is a lower record than the 750 watts would give, although the two 750 watt heaters take less current than the four 500 watts. The air space is so much larger for the 500 watts that they would heat the air more rapidly and could be shut off sooner. These low results are obtained by my method of

regulating the air instead of the electricity to the heater, as the air, not the resistance of the wire, is the variable.

I also used these heaters in my house heating four rooms, about 7,000 cubic feet. The temperature was nearly constant at 65 degs. F., varying only 2 or 3 degs. above or below. These heaters consumed about 30 kilowatt hours per day, which at one cent per kw. hour would be \$9 per month. To heat these rooms with coal it would have taken about $1\frac{1}{2}$ tons in a stove or $1\frac{1}{2}$ in a furnace. This makes electric heating equal to coal at from \$6 to \$7 per ton at the above price. In street car work the cost of heating cars, that is, sixteen-foot cars, is from one to two cents per hour of service, at the rate as given at the convention in Milwaukee, that is, .9 cent per kilowatt hour.

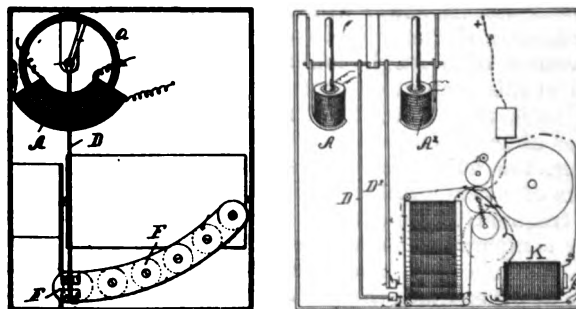
The electric heaters, I may add, as designed by the writer, consist of a coil of wire wound on an open insulated frame. Two or more of these frames are placed horizontally in proper cases so that the amount of cold air admitted can be regulated. The temperature of the wire is carried to from 300° to 350° F.

THE OLAN ELECTRIC CURRENT RECORDER.

Approximate and aggregate results in the measurement of electric currents cannot be satisfactory to all parties interested. It is not enough that a consumer of electric current is told that he has received so and so many watts or amperes hours during a certain period. He wants a proof of the correctness of such a statement, and further, he frequently wants to know under what conditions he has received the current so as to enable him to judge what use he has had from it. The electro-metallurgist, for instance, if he needs 100 amperes at two volts tension cannot be satisfied if he receives two amperes at 100 volt tension, nor can a consumer of electric light be satisfied with 60 volts when he needs 120.

It is thus evident that the only instrument satisfying all conditions for measuring electricity must be one which not only gives a lasting, permanent record of the amount of current that has passed through a circuit per unit of time, but also indicates under what conditions the current has passed.

An instrument of this description has recently been devised and patented by Mr. J. W. T. Olán, of this city. It consists principally, as shown in the accompanying illustrations, of a record sheet moved by time mechanism and passing over a support plate, where it is marked, two pointers moving in co-relative arcs over the plate and sheets and governed, respectively, by variations of the E. M. F. and quantity of



FIGS. 1 AND 2.—THE OLAN ELECTRIC CURRENT RECORDER.

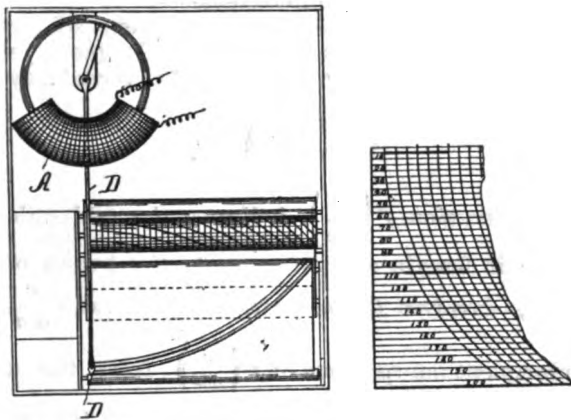
the current. In this way a permanent and co-relative record is made of the E. M. F., as well as the quantity of the current for a certain period of time. The record sheet may thus be used as corroborating evidence for regulating accounts between supply companies and consumers.

The record sheet is provided with lines and figures to indicate the quantity and potential of the current, and is moved by a time mechanism. By this means when the

quantity as well as the tension of the current that have passed through the circuit in a given time are shown on the record sheet, the corresponding resistance is known, and the whole of Ohm's law with relation to the current in the circuit is therefore practically recorded.

In the illustrations, Figs. 1 and 2 represent front and side views, respectively, of the recorder, with the face plate removed. Here the coil A actuates the pointer D to a degree corresponding to the voltage, and A' is a similar coil, but of low resistance, and actuates the pointer D' to indicate the amperage. The two arms can be arranged to make their records on a single sheet in concentric arcs, or upon different sheets placed side by side so that their indications shall register and read together.

The pointers make their indications by perforating the sheet at intervals. For this purpose the magnets F are energized and the pointers, carrying relatively heavy armatures near their free ends, vibrate rapidly and puncture the recording strip. Another method, in which the record is made by a spark instead of the vibrating needle, is



FIGS. 3 AND 4.—THE OLAN ELECTRIC CURRENT RECORDER.

shown in Fig. 3, and Fig. 4 shows a section of the record sheet.

We are informed that a company has been formed to introduce this device.

MAGNETIC LEAKAGE IN DYNAMO-ELECTRIC MACHINERY.—II.

BY

Alfred E. Wiener.

B. General Formulae for Relative Permeances.

In order to obtain the values of the permeances of the various paths, we start from the general law of conductance:

$$\text{Conductance} = \left\{ \begin{array}{l} \text{Conductivity} \\ \text{of medium} \end{array} \right\} \times \frac{\text{Area of medium}}{\text{Distance in medium}},$$

or, in our case of magnetic conductance:

$$\text{Permeance} = \text{Permeability} \times \frac{\text{Area}}{\text{Length}}.$$

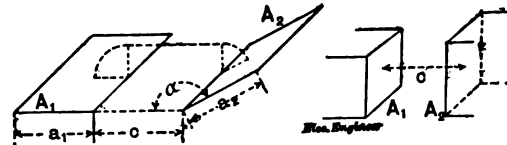
Since the permeability of air = 1, the relative permeance between two surfaces can be expressed by the general formula:

$$P = \frac{\text{Mean area of surfaces exposed.}}{\text{Mean length of path between them.}} \dots (6)$$

From this, formulæ for the various cases occurring in practice can be derived.

(a). Two plane surfaces, inclined to each other.

In order to express, algebraically, the relative permeance of the air space between two inclined plane surfaces, Fig. 1, the mean path is assumed to consist of two circular arcs joined by a straight line tangent to both circles, said arcs to be described from the edges of the planes nearest to



FIGS. 1 AND 2.

each other, as centres, with radii equal to the distances of the respective centres of gravity from those edges. Hence:

$$P = \frac{\frac{1}{2}(A_1 + A_2)}{c + \frac{a_1 + a_2}{2} \times \frac{\pi}{2} \times \frac{\alpha}{180^\circ}} \dots (7)$$

where A_1, A_2 = areas of magnetic surfaces;

c = least distance between them;

a_1, a_2 = widths of surfaces A_1 and A_2 , respectively;

α = angle between surfaces A_1 and A_2 .

(b). Two parallel plane surfaces facing each other.

If the two surfaces, A_1 and A_2 , are parallel to one another, Fig. 2, the angle enclosed is $\alpha = 0^\circ$, and the formula for the relative permeance, as a special case of (7) becomes:

$$P = \frac{\frac{1}{2}(A_1 + A_2)}{c} \dots (8)$$

(c). Two equal rectangular surfaces lying in one plane.

In case the two surfaces lie in the same plane, Fig. 3, they inclose an angle of $\alpha = 180^\circ$, and the permeance of the air between them, by formula (7), is:

$$P = \frac{a \times b}{c + a \times \frac{\pi}{2}} \dots (9)$$

a = width of rectangular surface;

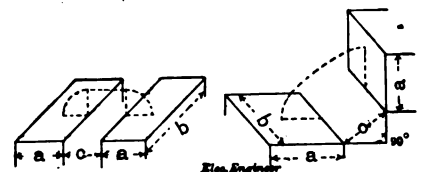
b = length " " " "

c = least distance between surfaces.

(d). Two equal rectangles at right angles to each other.

If the two surfaces are rectangular to each other, Fig. 4, the angle $\alpha = 90^\circ$, formula (7), consequently, reduces to

$$P = \frac{a \times b}{c + a \times \frac{\pi}{4}} \dots (10)$$



FIGS. 3 AND 4.

(e). Two parallel cylinders.

In case the two surfaces are cylinders of diameter, d , and length, l , Fig. 5, the areas of their surfaces are $d \times \pi \times l$; and if they are placed parallel to each other, at a distance, c , apart, the mean length of the magnetic path is $c + \frac{1}{2}d$; hence the permeance of the air between them:

$$P = \frac{d \times \pi \times l}{c + \frac{1}{2}d} \dots (11)$$

In this formula, the expression for the mean length of the path is deduced from Fig. 6, in which it is assumed that the mean path consists of two quadrants joined by a straight line of length c , and extends between two points of the cylinder-peripheries situated at angles of 60° from the centre line.

Since in an equilateral triangle the perpendicular, dropped from any one corner upon the opposite side, halves that side, the perpendicular, from either of the endpoints of the mean path upon the centre line, bisects the radius of the corresponding cylinder-circle, and the radius of the

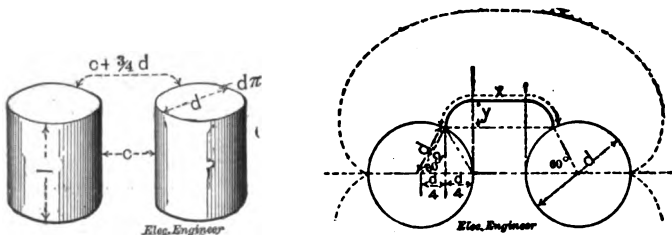
leakage-path quadrant is $y = \frac{d}{4}$; hence the length of the mean path :

$$x = c + y \times \pi = c + d \times \frac{\pi}{4},$$

or, approximately : $x = c + \frac{1}{2}d$.

This approximation even better meets the practical truth, as most of the leakage takes place directly across the cylinders, and the mean path, therefore, in reality is situated at an angle of somewhat less than 60° , which was taken for convenience in the geometrical consideration.

For the case of two parallel cylinders, Prof. Silvanus P. Thompson, on page 147 of his "Lectures on the Electro Magnet," has resorted to the theoretical formula for the



FIGS. 5 AND 6.

resistance of a medium, of conductivity μ , between two parallel cylinders of radius, a , of distance apart, b , and of unit length (1 cm.):

$$R = \frac{1}{\mu \pi} \times \log_{\text{nat}} \frac{2a}{b + 2a - \sqrt{b^2 + 4ab}}$$

Replacing, in this, $2a$ by d , the symbol for the diameter, and using the symbol c instead of b for the distance apart of the cylinders, we obtain :

$$R = \frac{1}{\mu \pi} \times \log_{\text{nat}} \frac{d}{c + d - \sqrt{c^2 + 2cd}}$$

In the case of magnetic resistance, i. e., reluctance, since the permeability of air = 1, we have

$$R = \frac{1}{\pi} \times \log_{\text{nat}} \frac{d}{c + d - \sqrt{c^2 + 2cd}}$$

and therefore the permeance, which is the reciprocal of the reluctance :

$$P = \frac{1}{R} = \frac{\pi}{\log_{\text{nat}} \frac{d}{c + d - \sqrt{c^2 + 2cd}}}$$

By dividing numerator and denominator of the logarithm by $d\pi$, we obtain :

$$P = \frac{\pi}{\log_{\text{nat}} \frac{1}{\pi \left[\left(\frac{c}{d\pi} \right) + \frac{1}{\pi} - \sqrt{\left(\frac{c}{d\pi} \right)^2 + \frac{2}{\pi} \left(\frac{c}{d\pi} \right)} \right]}}$$

or, transforming into ordinary logarithms, 2.3026 being the modulus of the hyperbolic logarithms :

$$P = \frac{\pi}{2.3026 \times \log \frac{1}{\pi \left[\left(\frac{c}{d\pi} \right) + \frac{1}{\pi} - \sqrt{\left(\frac{c}{d\pi} \right)^2 + \frac{2}{\pi} \left(\frac{c}{d\pi} \right)} \right]}}$$

Inserting the numerical value for π , we finally get

$$P = \frac{1.3644}{\log \frac{0.3183}{\left(\frac{c}{d\pi} \right) + 0.3183 - \sqrt{\left(\frac{c}{d\pi} \right)^2 + 0.6366 \left(\frac{c}{d\pi} \right)}}$$

Since, in this equation, $\left(\frac{c}{d\pi} \right)$ is the only variable quan-

tity, it is evident that the permeance per unit length between two cylinders is independent of their absolute size, but depends only upon the ratio of their least distance apart to the perimeter of the cylinders,—and the values of P for various ratios of $c : d\pi$ may be calculated and arranged in tabular form for convenience.

Although Prof. Thompson has in fact done so¹ (see his table, page 149, Lectures on the Electro Magnet), yet his method,—which in the thus simplified form may be expressed by :

$$P = f\left(\frac{c}{d\pi}\right) \times l,$$

where the function, $f\left(\frac{c}{d\pi}\right)$, indicates the table-value of P , for unit length, and l represents the length of the cylinders,—involves the evaluation of the ratio $\frac{c}{d\pi}$, and

the subsequent interpolation of $f\left(\frac{c}{d\pi}\right)$ from the table,

while formula (11) gives P directly, without the use of a table, by a single division.

Besides, it can be mathematically demonstrated that Prof. Thompson's formula, and, in consequence, his table also, depart from the practical truth. For, according to the general permeance-formula (6), the value of P must be the mean area, divided by the mean length of the path, and, in the case of two cylinders, the mean length of the path must be larger than the smallest distance apart, c , of the cylinders, and therefore in the expression for the mean length,

$$c + k \times d,$$

the constant, k must always be positive. Now, Thompson has calculated P for various values of the ratio $\frac{c}{d\pi}$; considering any one, n , of these, we have

$$\frac{c}{d\pi} = n, \text{ or } c = n \times d\pi;$$

for unit length of cylinders, $l = 1$, therefore, from formula (6):

$$P = \frac{d\pi}{n \times d\pi + k \times d} = \frac{\pi}{n\pi + k}$$

From this follows, directly :

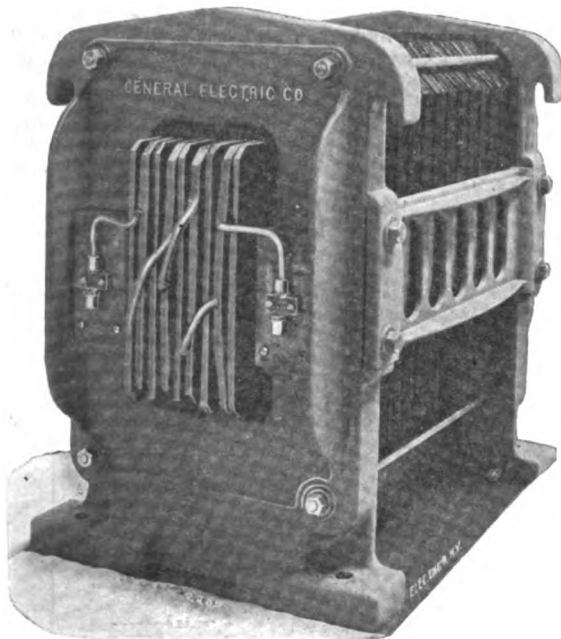
$$k = \frac{\pi - P \times n\pi}{P} = \frac{\pi}{P} (1 - P \times n).$$

¹ As an example of this rather troublesome calculation, which is not shown by Thompson, but which may be of interest to many possessing his valuable book, the numerical value of P for the first ratio in Thompson's table, $\frac{c}{d\pi} = 0.1$, is here figured :

$$P = \frac{1.3644}{\log \frac{0.3183}{0.1 + 0.3183 - \sqrt{0.01 + 0.6366 \times 0.1}}} = \frac{1.3644}{\log \frac{0.3183}{0.4183 - \sqrt{0.07396}}} = \frac{1.3644}{\log 0.1469} = \frac{1.3644}{-0.83582} = 4.0287.$$

THE GENERAL ELECTRIC 200 KILOWATT TRANSFORMER.

IN THE ELECTRICAL ENGINEER of Aug. 15, appeared an article, describing the new General Electric 200 kilowatt static transformers which are about to be installed at Niagara Falls. We are now able to give our readers a view of the finished machine, of which, it will be remembered, there are two to each rotary transformer. They have been designed with great care in order to fulfill the exacting requirements of the specifications, which call for an efficiency of 97 per cent. at full load and a temperature limit of 40 degrees C. rise above the surrounding air for a continuous run. In order to fulfill these conditions the transformers have been designed so as to admit of thorough ventilation. For this purpose the transformers are built up of laminated sheets in the usual



GENERAL ELECTRIC 200 KILOWATT TRANSFORMER.

way, but instead of being bolted into one solid mass the laminations are divided up into sections, through which air is forced from below.

TELEGRAPHIC COMMUNICATION BY INDUCTION BY MEANS OF COILS.

In a paper recently read before the Royal Society of Edinburgh, by Mr. C. A. Stevenson, the results are detailed of some experiments with the view of establishing communication between North Unst lighthouse, situated on Muckle Flugga, and the main land, and thence to the lighthouse station at Burracoff, a distance of two miles. A number of experiments were made in the laboratory to discover the laws of the action of coils on each other, with a view of calculating the number of wires, the diameter of coils, the number of amperes, and the resistance of the coils that would be necessary to communicate with Muckle Flugga, and after a careful investigation, it was evident that the gap of 800 yards could, with certainty, be bridged by a current of one ampere with coils of nine turns of No. 8 iron wire in each coil, the coils being 200 yards in diameter. It was found that 100 dry cells, with 1.3 ohms resistance each and 1.4 volts, gave good results, the observations being read with great ease in the secondary by means of two telephones. The cells were reduced in number down to 15, and messages could still easily be sent, the resistance of the primary being 24 ohms and the secondary 260 ohms. The hearing distance is said by Mr. Stevenson to be proportional to the square root of the diameter of one of the coils, or directly as the diameter of the two coils, so that, with any given number of amperes and number of turns, to hear double the distance requires double the diameter of coils, or double the number of turns, and so on. But this is within certain limits, for when the coils are close to one another the law does not hold. With regard to the question whether or not the parallel wire system is actuated by induction or conduction, it will, Mr. Stevenson says, depend how

the ends are earthed, or, in short, what is the distance bridged in comparison to the breadth of base, which predominates. Where the wires are long in comparison with the distance bridged, conduction will be the main working factor, but when the base is small, and the distance bridged is large in comparison, induction will be the main factor, and the number of turns then increases the effect.

AN IMPROVEMENT IN THE MANUFACTURE OF CARBONS.

In illustration of a practical advantage accruing as a direct result of a piece of pure research, the following may be noticed: MM. Despretz and Berthelot described before the Paris Academy of Science some time ago some experiments which they instituted with the object of studying the conditions under which carbon fuses and sublimes. Among other things they discovered while engaged in this investigation, that when exposed to the action of high temperatures the various kinds of carbon pass into the graphitic condition. This result possibly did not strike anyone at the time as being capable of commercial application; it appeared what it professed to be, a piece of pure research. MM. Girard and Street, however, have succeeded in basing upon this result the manufacture of graphitic carbon suitable for various electrical purposes. Carbons made in the ordinary way are subjected to such a temperature as will soften, weld, and even fuse and sublime the material. The temperature is kept up until they are converted into graphitic carbon or graphite. To obtain the necessary heat, the carbon that is being converted is made part of an electric circuit, or else an arc is caused to play over its surface, in which case the graphitic character is produced to a certain depth. Granular and powdered carbon is similarly altered by passing it between electrodes, the rate of flow being adjusted so that the whole of it is brought up to the requisite temperature. Such graphitic carbon may be used in the manufacture, by agglomeration, of the various "carbons" which are used in electrical work.

THE PRECIPITATION OF METALS FROM SOLUTION BY AN ELECTRIC CURRENT.

A SEARCHING investigation into the separation of metals from their dilute solutions has recently been concluded by F. Mylius and O. Fromm. The experiments concerned the phenomena occurring in the precipitation of one metal by another as well as in the electrolysis of solutions. For the work as a whole we refer our readers to the *Berichte der Deutschen Chemischen Gesellschaft*, xxvii., 1894, pp. 630-651. We give, however, the conclusions arrived at as regards precipitation by the electric current. They are as follows:—1. The heavy metals may be separated more or less easily from their dilute solutions in the form of black, porous and apparently non-crystalline precipitates. 2. Silver and copper precipitated in this way may absorb or occlude hydrogen during the passage of the current, but the greater part of this gas escapes when the circuit is opened. 3. Silver and copper precipitates exhibit spontaneous change into the crystalline state, frequently accompanied by the evolution of hydrogen. 4. The conversion of the black into the crystalline modification is hastened by the action of metallic salts, acids and oxidizing agents, the metals in this respect being analogous to the alloys. 5. The black variety of copper containing hydrogen is essentially different from Wurtz's copper hydride. 6. An electrolytic method of formation of copper hydride no more exists than does a process of preparing the same body by means of zinc. 7. The black precipitate frequently observed on the zinc of a Daniell's cell consists of a copper-zinc alloy. The same substance separates and is deposited on the copper plate when the cell is exhausted.

LIGHTNING PROTECTION FOR SHIPS IN DRY DOCK.

WRITING to Rear-Admiral J. A. Fisher, C. B., on the death by lightning of two men who had sought shelter under a vessel in the Norfolk, Va., dry dock during a thunder storm, Lord Kelvin says:

"With reference to the recent report of a lightning discharge in Norfolk Dockyard, U. S. A., by which two men were killed, it is proved by that accident that to secure against danger to men working under a ship in dry dock there ought to be a thorough metallic connection, by wire rope or otherwise, between several points of the ship's iron, such as bollards, ring-bolts, etc., and iron pipes leading to the water outside the dry dock. Similar precautions ought to be taken in respect to the frames of ships on the stocks in the course of building, although we have, so far as I know, never heard of an accident from lightning happening to men at work in the building of ships. An iron ship simply resting on wooden blocks, and without any connection by metal with the water of docks, or river, or sea in the neighborhood, is certainly dangerous to persons standing on the ground and touching any part of the iron hull during a thunderstorm." A contemporary remarks that precautions of this character are to be adopted in all the English Government dockyards.

ELECTRIC TRANSPORTATION DEPARTMENT.

THE THREE-WIRE TROLLEY SYSTEM AT BANGOR, ME.¹

BY J. G. CARROLL.

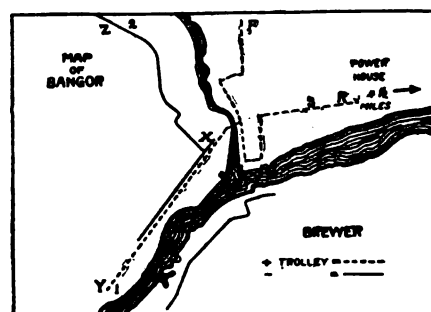
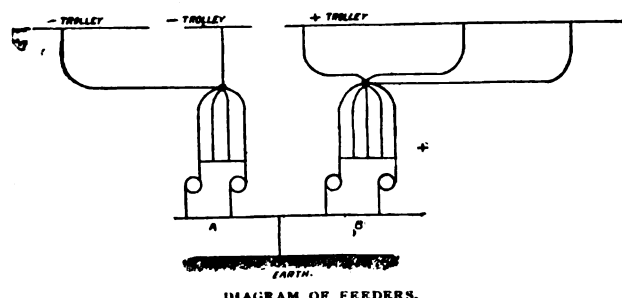
Having noticed an article in one of the electrical journals² suggesting the feasibility of operating an electric railway by the three wire system, I became much interested, particularly as the road I am connected with has been using that method for some three years. The article stated that such method was possible or practicable only on double track roads. I will endeavor to make clear how it is possible to operate a single track road by such methods. In the first place our power plant being situated $4\frac{1}{4}$ miles from the nearest point of the road, it was necessary that some means be devised to avoid the enormous expense that would be incurred in getting the copper wire necessary to have a metallic circuit. We tried in the first place to get a ground return by putting copper ground plates in the river at different points along our route and at the power station, but to no purpose. A portion of our line $2\frac{1}{2}$ miles long, situated in the city of Brewer, is connected at each hydrant with the rail, and as we operate the water system of that city, and the pumping station is in the same building as the railway power plant, this gives us a good return when needed. But operating as we do now by the three wire system, this is unnecessary when in balance. We have 7.74 miles of single track with seven turnouts. The rail is 85-pound, one-half tram and the balance T-rail. The system consists of two distinct roads, one in the city of Brewer about $2\frac{1}{2}$ miles long and the other in

the ends of the line on the Brewer division. In operation one car bound from X to Z takes the negative wire. One car bound from X to Y takes the positive wire. One car is bound from X to F and one from X to B on the positive side. This arrangement gives us five cars on the positive side and four on the negative. As long as this balance is maintained, everything runs smoothly. In putting on extra cars we have occasion to run them only from Y, which is a point opposite the fair grounds to X, which is the business centre of the city. By making these extra cars use alternate wires, this balance is still maintained. We have a number of heavy grades and short curves. In fact, there is scarcely a level piece of track in Bangor. For instance, on the Pearl street line we have a grade of 6 per cent. for 200 feet; on Main street one of 8 per cent. for 100 feet; on Olive street one of 7 per cent. and two of 5 per cent.; on Center street one of 8 per cent. for 200 feet; and in Brewer four of 6 per cent., one of which is 500 feet long.

The one bad feature of this system is that in case of a generator getting disabled we are out of balance by having two machines on one side and one on the other. This we intend to remedy by having a spare generator ready to put in on either side, as may be necessary.

MR. SACHS ON "CONDUIT RAILWAYS."

WITH the enormous growth, present and prospective, of electric street car traction, special interest is attached to an article on



FIGS. 1 AND 2.—OPERATION OF BANGOR & BREWSTER TROLLEY ROAD ON THE THREE-WIRE SYSTEM.

Bangor, $5\frac{1}{4}$ miles. By reference to the map it will be seen that there is no connection between the two. The rails are bonded at the joints with No. 4 copper bonds and connected at each joint with a supplementary No. 4 copper wire.

Our power plant consists of four Thomson-Houston generators, driven by four Holmes turbine wheels of 120 horse-power each. Our equipment consists of two F-30 motors under each car. We operate in regular service nine motor cars, and nearly every week day run three additional motor cars, drawing three trolley cars. We connect our generators as in Fig. 1, each two machines being connected in multiple. For convenience we will call two machines on one side A and the other two B. The positive side of group A is connected to earth and the negative of B to earth; the positive of B to line and the negative of A to line. From B is run a main composed of five No. 0 wires and from A is run a main of four No. 0 wires. The mains terminate at a point near the centre of the city and three feeders are run from B to different points along the positive trolley wire, while two feeders are run from A to the two sections of negative trolley wire indicated by the map. It will be seen that there are two trolley wires from X to Y. From one of these a branch runs to Z. The wires from X to Y are of different polarity, and of course carefully insulated from each other. The use of two wires does away with the use of overhead frogs at turnouts and serves another important purpose in the balancing of the system which will be explained later.

In order to operate successfully the load on each side must be equal or nearly so. This we accomplish in the following manner: Our time table and turnouts are so arranged as to admit of a 15 minute schedule. Every 15 minutes four cars are at X and at the same time three are at the ends of the routes 1, 2 and 3. This applies to the Bangor divisions. At the same time two cars are at

"Conduit Electric Railways," written for *Cassier's Magazine* for September by Joseph Sachs who illustrates and describes in a very thorough manner the various conduit type modifications which have been proposed and tried. To street railway men the article is of special interest and value.

MOISSAN'S CONTINUOUS ELECTRIC FURNACE.

Much space is given in the *Comptes Rendus* to a description of a continuous electric furnace in which materials may be melted out of contact with the carbon vapor of the arc. The body of the furnace is constructed of bricks of lime surrounding a central cavity, the sides of this cavity being lined with alternate plates of carbon and magnesia, the latter being next the lime, as, if the carbon plates were in contact with the lime combination would occur at the high temperatures reached, liquid calcium carbonate being formed. The magnesia plates are irreducible by carbon, and therefore can only waste away by direct volatilization. The cavity is closed with simple plates, above which is placed a block of lime. The arc carbons pass through opposite walls of the furnace and the arc is struck between them in the centre of the cavity; below the arc and above the bottom a tube of pure carbon, one or two centimetres in diameter, passes through the furnace from side to side and is inclined at an angle of thirty degrees to the horizontal. The ores to be fused are placed in this tube and the arc struck, the metal as reduced flowing down to the lower end of the tube, where it can be collected. Using a current of six hundred amperes at sixty volts, an ingot of chromium of two kilograms weight has been produced; the fused metal was cast in moulds of sesquioxide of chromium, to which it gave up any carbon it originally contained. The heated part of the carbon tube is transformed into graphite.

1. *Street Railway Review*.

2. *THE ELECTRICAL ENGINEER*, May 30, 1894.

ELECTRICITY AS A FIRE HAZARD.—IX.

BY W. J. JENES.

(Concluded.)

These ideas are not original with the writer of the present paper. They have long been advocated by some engineers who were very early skilled in the incandescent electric lighting art, among others the well known Consulting Electrical Engineer of the World's Columbian Exposition, Mr. L. Stieringer, to whose practical inventive genius and large experience in illumination by other agents, the present success of the lighting of the Manufactures Building by coronas, the beauty of the electrical fountains and other features of the Fair are due. In THE ELECTRICAL ENGINEER of June 8, 1892, Mr. Fremont Wilson, a well-known inspector of New York, made the following vigorous expression:

"Two and a half years ago the writer was asked for an opinion in regard to interior conduits, and to the surprise of the party asking the question, he said: 'Interior conduits to be successful must be able to stand the action of all kinds of alkali in plasters, and must be absolutely proof against the tools of mechanics, and, furthermore, absolutely water-proof and fire-proof, and must not be relied upon for insulation, the only place for insulation being upon the conductors themselves.' The question was then asked: 'Why, then, do the New England Underwriters insist upon the use of conduits, and, furthermore, allow the use of such cheap grades of wire?' The reply was, that any party or parties who recommended any conduit then on the market, or demanded its use, and allowed twin conductors with cotton insulation, was either ignorant of the entire subject or was interested; for the only conduit that was needed was that used by the gas man, viz., iron pipe, to be made and installed under certain specifications. The writer also had the word of one of the largest pipe makers that a first-class article of piping with right and left threads could be placed on the market at the same price as gas pipe and perhaps cheaper; but the trouble with this system was simply that it could not be patented, and therefore, underwriters, architects and owners of buildings must be kept in blissful ignorance of the safety and feasibility of iron conduits so as to enable conduit people to line their pockets with the money of the poor public.

"For this answer the writer was severely criticised by certain parties, but, nevertheless, time has proved that the remarks were correct, inasmuch, as, at the convention held at Buffalo in February, of this year, Capt. Brophy, formerly of the Boston Insurance Exchange, was forced to admit that the conduits used were a failure.

"The writer over two years ago installed in New York an installation of over 8,000 lamps, and all the primary feeders connecting the various converters were placed in gas pipes. The pipes were laid on the iron ledges of the building and white core taped wire used; and, although these pipes and wires of a total length of about two miles were placed in position by inexperienced men, yet they have been in constant successful use for eighteen months, conveying a current of 15 amperes and 1,000 volts, constantly exposed to the weather; and yet we hear that it can't be done—that to install iron pipes and pull in wires for use at 50 or 100 volts pressure would be suicidal. Is not every combination gas fixture an example of conduits?

"That the conduit people have seen their blunder is only too evident as we all know, from the fact of their covering their present material with metal; but let us hope that before long the underwriters will not only allow, but insist on, solid metal conduits specially built and installed in all classes of concealed work, and then, and not till then, will this everlasting hue and cry about electric light fires cease.

"The New Orleans Underwriters have just adopted a stringent rule in regard to conduits, but they are simply recommending a special conduit, although it does not show on the face of their order, and they will go through the same experience, only in a less degree, that the Boston Underwriters have passed through. There is, in the writer's judgment but one conduit; and let us learn a lesson from our enemy the gasman, and use it—the iron one. I may add that the Chicago Underwriters have recently stated that they are in favor of iron conduits; and the question must soon be faced by all concerned."

At the close of his Cornell University lecture, from which quotations are elsewhere made, Mr. C. J. H. Woodbury states some plain facts bearing upon the perishable character of the insulating coverings and conduits used in the wiring of buildings, as follows:

"The status of uses of electricity for illumination and power is so well established upon a practical basis, as regards the service to be expected and the character of the attendance required, that there is but little of a tentative or experimental nature in such work, and there is therefore no excuse for the continuance of many of the temporary methods of insulation which have been in such general use.

"One of the pernicious results liable to occur as a consequence of such methods of installation is the depreciation of such apparatus—from which I apprehend that difficulties may arise in future."

In the *Journal* of the (London) Society of Arts of May 5, 1893, appears this concise and forcible statement, more telling than any words of mine, because from the pen of Prof. Silvanus P. Thompson, universally recognized as one of the most forcible and reliable of electrical writers:

"In house-wiring, too, practice differs. The wooden casing that, thanks to the fire-office rules, is almost universal in England, is by no means universal elsewhere, and, in some countries is almost unknown. It is probably destined to disappear in time, when safer modes of carrying wires are recognized. Wood-casing has three grave defects—it is neither damp-proof nor incombustible, and, too often, it covers, like charity, a multitude of sins. In this connection it is important to note that, in spite of the curious predilection of so many of our fire-officers toward the use of wood-casing, the proportion of electrically-caused fires in this country is extremely low. This satisfactory circumstance must be attributed, not to the general use of wood-casing for house wires, but rather to the very wholesome dread inspired by the vigilant and able surveyors of the chief fire-officers, of whom Mr. Musgrave Heaphy is the most eminent, and who have, in spite of the curses so frequently showered upon their heads, insisted upon the prime requisites of good material and sound workmanship in all risks that they undertake to insure. If their requirements have seemed, in individual cases, hard or arbitrary, they have done incalculable good in stamping out the inferior work of scamping contractors. It is an open secret that some of the New York fire-officers have become of late very uneasy about the increasing prevalence of electricity-caused fires. It is even stated, though I cannot name my authority for the information, that some of them have recently sent representatives to this country to learn how we manage to keep electric lighting safe. Doubtless we shall, at Chicago, exchange opinions on many of the details of this highly practical question. What is wanted is a mode of running the wires and fixing the switches and other accessories that shall not only be electric-tight, but shall also be water-tight, gas-tight, air-tight, oil-tight, fire-tight, and rat-tight."

In connection with the subject of the opinions of the electrical and insurance authorities of Europe and the practices which they there approve, an interesting statement is made by Mr. William McDewitt, electrical expert of the Philadelphia Fire Underwriters Association and the Philadelphia Fire Patrol. Mr. McDewitt has long been recognized as the guardian of good practices in electric wiring in a large territory south and west of New York City, and in the early part of the present year made a visit to Europe to examine from the underwriters' standpoint into the methods of wiring and general electrical operation there employed. His report says, among other things:

"There does not appear to be any uniform system of installation rules in Europe; one prominent company issues a code of rules for its own protection, but each insurance company makes inspections for itself.

"I see no radical difference between the interior wiring in the cities visited and our own. Interior conduit work, concealed work, moulded work and surface work is used as much as it is in this country and in about the same proportion. In making comparison, therefore, I think I can save time by simply considering only the points where we differ.

"The second great difference is that they trust throughout to the insulation on the wires. We on the contrary, do not trust to the insulation alone, but also upon the way the wiring is done. They use only one or two kinds of insulation (practically), all of the best quality of rubber. The question as to which is the best, to trust to the covering on the wire alone or to proper installation, is an open one.

"After all has been said, the report that they do not have any fires or accidents from electric light wiring in Europe comes from those who are ignorant of what occurs. I called upon several insurance companies and endeavored to get from them some information as to the general results from the use of electricity, but found that there were no such electrical bureaus as are attached to our Fire Underwriters associations. Each company could only tell me of the electric fires which had occurred among its own risks. In one large insurance building visited, where electric lights were used, my opinion was asked regarding the installation which appeared to be very good, yet it was admitted that two fires had occurred from the wiring.

"When interviewing the electric light contractors, I found that they were all very willing to talk and relate occurrences of electric fires and curious freaks of the electric current, and at the same time exhibit specimens of dangerous electric defects developed in buildings where electric lights are used. These interviews seem to prove that they have experienced as much trouble as we have had, and in comparing the size of the installations, probably just as many little accidents and fires if the investigation of electric dangers were followed and watched as closely as with us. I concluded from the talks with various superintendents and contractors that in comparing results we are all pretty much on a level."

PROTECTION FROM LIGHTNING.¹

BY ALEXANDER MCADIE, U. S. WEATHER BUREAU.

I.

At the Aberdeen meeting of the British Association for the Advancement of Science Sir William Thomson made the remark, "If I urge Glasgow manufacturers to put up lightning rods they say it is cheaper to insure than to do so."

This was the answer given by practical business men, concerned only with questions of profit and loss, to the foremost physicist of our time; and their answer will serve as fairly representing views widely held, founded upon the double belief that the risk from lightning is not so very great and the protection afforded by the present methods not sufficiently certain to warrant implicit confidence and justify the necessary expense.

The recent remarkable experiments of Dr. Oliver Lodge, in his lectures before the Society of Arts, opposing and to some degree directly contradicting the empirical rules of the Lightning Rod Conference, have given support to the belief that the protection was uncertain. Indeed, realizing that this work might be misinterpreted, Lodge has stated "an idea at one time got abroad that my experiments proved existing lightning conductors to be useless or dangerous; this is an entire misrepresentation. Almost any conductor is probably better than none, but few or no conductors are absolute and complete safeguards. Certain habits of lightning rod practice may be improved and the curious freaks or vagaries of lightning strokes in protected buildings are intelligible without any blame attaching to the conductor; but this is very different from the contention that lightning rods are unnecessary and useless. They are essential to anything like security."

What Lodge's brilliant experimental work does show is that the momentum of an electric current can not be overlooked in a lightning discharge. The old "drain-pipe" idea of conveying electricity gently from cloud to earth must give place to the new proposition, based upon recent discoveries, that even draining off must be done in an appropriate way to be effective. To illustrate, the rocks and trees upon a mountain side may influence and determine the course of a mountain stream, but even a good sized channel would not suffice to carry off safely an avalanche, or control the path of a landslide; so with lightning. In the past four years we have learned, through the work of Hertz and others, that when an electric current flows steadily in one direction in a cylindrical wire its intensity is the same in all parts of the wire; but if the current be of an oscillatory character, i. e., a current which rapidly reverses its direction, the condition no longer holds, and if the alternations are very rapid the interior of the wire may be almost free from current. If lightning then be a discharge of an oscillatory character, it may happen that the current down the lightning rod would be only *skin* deep. The experiments of Tesla and Elihu Thomson with currents of great frequency of alternation and very high potentials open the door to systematic study of discharges such as the ordinary lightning flash. In daily work currents of this type are coming more and more into prominence, and the time is not far distant when the lightning flash will be studied as an electrical discharge of this character. Protection entirely adequate for such discharges will then be forthcoming. Indeed, the reasons why present methods occasionally fail are now understood, and the proper remedies apparent.

And first let us see whether it is cheaper to insure than to provide proper protection. Foreign countries, especially Germany, France and Great Britain, have recognized the importance of obtaining reliable data concerning the loss of life and damage to property through lightning. Perhaps the work of the Royal Prussian Bureau of Statistics² gives the fullest and most detailed accounts of the damage done by lightning in Germany, and the relative injury. Statistics are available for the number of houses struck, the number of fires, the character of the roofing, soil, etc.

In 1891 the Weather Bureau issued to its observers instructions to report at the end of every month the names, with corroborative dates and places, of all persons killed by violent windstorms, tornadoes, and lightning. During 1890 somewhat similar statistics had been gathered, but the returns were less systematically arranged. In preparing the Weather Bureau lists, observers were directed to examine all daily papers published in their respective cities, consult all local authorities, and make inquiry if necessary. Naturally, where dependence was had upon newspaper items, there resulted much duplication, but in verifying names and dates the duplicates quickly appear and exaggerated reports are easily confined to proper limits.

Mr. H. F. Kretzer, of St. Louis, Mo., has for some years tabulated the number of deaths due to lightning, and has kindly placed his lists at the disposal of the Bureau. His sources of information were 192 newspapers, daily, weekly, and monthly. He found for five years, 1888-'97, a total of 1,080 deaths caused by lightning, or a yearly average of 206.

This agrees very well with the Weather Bureau records which I have tabulated.

Deaths Due to Lightning in the United States, Weather Bureau Records.

Month.	1890.	1891.	1892.	1893.
January.....				
February.....				
March.....	3	13	5	19
April.....	6	22	27	17
May.....	8	73	74	66
June.....	27	62	67	73
July.....	55	84	54	18
August.....	127	9	15	8
September.....		6	6	2
October.....			1	
November.....			2	1
December.....				
Total	120	204	251	209

Or 784 lives in four years, an average of 196 lives per year.

A glance at the table shows that these lives were practically all lost in five months—April to September—and that in June and July the maximum death rate occurs.

The Weather Bureau records unfortunately do not give information as to the extent of damage to property. To get at something like a fair commercial estimate of the destruction of property by lightning, I have made use of the "Chronicle Fire Tables" for the eight years 1885-'92. It is hardly necessary to remark that these tables are compiled from the reports of the fire departments, insurance companies, and the reports of fires in the public press, and represent a high degree of accuracy.

From information contained in these volumes, the following tables have been compiled:

Fires Caused by Lightning.

Year.	Number of Fires.	Loss on Original Risk.
1885 to 1890, inclusive.....	2,200	\$3,385,885
1891.....	457	1,355,526
1892.....	539	2,921,484

Or, in eight years, ending 1892, in the United States, and for the most part West of the Rocky Mountains, 3,516 fires, with a loss of \$12,663,885.

It is very evident, therefore, that the damage done by lightning is no inconsiderable matter to be lightly passed over or turned off by replies such as the one given by the Glasgow manufacturers. It is certainly worth while to erect the proper protective apparatus.

Let us look now at the class of buildings most likely to be injured by lightning. The following table shows the number of barns, stables, granaries, churches, and dwellings set on fire by lightning during the years 1890, 1891 and 1892:

Year.	Barns, Stables and Granaries.	Churches.	Dwellings.
1890.....	363	90	121
1891.....	290	11	78
1892.....	495	29	177

During nine years ending 1892, 2,335 barns, 104 churches and 664 dwellings have been struck by lightning.

The question has often been raised whether there exists a periodicity in the number of lightning strokes. Statistics must cover a period of at least twenty years before an answer to this question can be given, but it is interesting to compare the number and kind of buildings struck for the last two years of which we have record.

It is of particular interest to study the geographical distribution of the dwellings and barns struck in these two years. There are some notable increases in certain States, the reasons for which are not at present discernable. Attention is directed to the figures in bold-face type in the table of States on the following page.

According to the statistics of the German bureau, previously referred to, the frequency of lightning stroke varies somewhat with the character of the land. Thus, in their investigations it

1. Circular of Information, U. S. Weather Bureau, Abstract.

2. Page VI. "Lightning Conductors and Lightning Guards."

3. Beiträge zur Statistik der Blitzschläge in Deutschland; von Dr. Hellman, Berlin, 1896.

was found that in flat lands 400 to 540 buildings were struck out of 1,000,000, the rate varying in different localities.

	1891.	1892.
Barns, granaries, and stables.....	290	495
Churches.....	11	29
Country and general merchandise stores.....	5	6
Dwellings and tenements.....	78	177
Electric light stations.....	1	2
Grain elevators.....	2	4
Grain fields.....	1	.....
Grain, hay, and straw in stack.....	10	12
Ice houses.....	4	4
Lighthouses and life-saving stations (no other source of fire reported).....	2	.....
Livery stables.....	4	4
Lumber yards.....	2	1
Oil refineries.....	2	2
Oil tanks.....	2	22
Railroad depots.....	5	7
Telegraph and telephone offices.....	2	3

The nature of the material used for roofing has also been considered. Classifying the various materials under the general heads "hard" and "soft," the German investigators found for ten years (1878-83) for Schleswig-Holstein, that of all the buildings struck, 9 per cent of those having *hard* roofs and 68 per cent. of those having *soft* roofs were set on fire. The nature of the building and the purpose for which it is used will, as we readily see also in our own statistics, influence the liability to stroke and fire.

State.	Barns.		Dwellings.	
	1891.	1892.	1891.	1892.
Connecticut.....	9	23	6	16
Delaware.....	4	5	.....	.....
Illinois.....	17	7	7	12
Indiana.....	31	38	7	9
Iowa.....	19	6	.....	.....
Kansas.....	1	2	.....	.....
Kentucky.....	3	4	.....	.....
Maine.....	21	23	7	16
Maryland.....	12	8	.....	.....
Massachusetts.....	12	15	8	12
Michigan.....	26	70	13	.....
Minnesota.....	7	5	4	6
Mississippi.....	1	.....	.....	.....
Missouri.....	2	1	2	3
Nebraska.....	1	.....	.....	.....
North Carolina.....	2	3	.....	2
New Hampshire.....	2	2	.....	.....
New Jersey.....	14	30	8	7
New York.....	30	117	5	23
Ohio.....	26	26	6	4
Oregon.....	2	.....	.....	.....
Pennsylvania.....	29	73	3	23
Rhode Island.....	1	4	.....	2
South Carolina.....	3	.....	.....	.....
South Dakota.....	3	3	.....	.....
Texas.....	4	7	.....	.....
Virginia.....	4	.....	.....	2
Wisconsin.....	6	11	2	3

One interesting point which appears to be shown by statistical studies of lightning stroke is the decreased liability to accident in *thickly settled* communities.

It may be said in general, that the risk in the country is five times greater than in the city. For ordinary dwelling houses, not unduly exposed in city blocks, lightning rods are hardly necessary, a very considerable protection being afforded by the tin roofing, numerous cornices, gutters, etc. The geological, as well as the topographical conditions, may have some influence upon the frequency of lightning stroke in a chalk formation, 2 will represent the liability to marl, 7 for clay, 9 for sand, and 23 for loam.

With regard to trees, the oak is more frequently, and the beech least frequently, struck. The values are something like, if 1 represents the frequency for the beech tree, 15 for pines, other trees generally averaged at 40, and 54 for oaks. Trees struck are most generally those standing in the clear or on the edge of forests, and in height averaging from 16 to 20 meters (52 to 66 feet). The trunk appears to be struck about three times as often as the boughs, and generally the stroke seems to travel to the ground. Only in three out of a hundred cases did it jump to other trees.

Mr. Symons,⁴ in his paper on thunderstorms, instances 16 trees struck. About one-third of these were elms, with the oak, ash, poplar, in order following, and one case each of crab-lime and willow.

It is interesting to recall at this point, the record made by Hugh Maxwell as early as 1787, that the elm, chestnut, oak, and pine were often struck, the ash rarely, and the beech, birch, and

maple never. This last, however, is not true. Indeed, it is not altogether plain just why some trees escape while others suffer. Capt. Maclear,⁵ discussing the action of lightning during a thunderstorm on June 6 and 7, 1889, found a great number of trees struck within a radius of 4 miles, and set to work to discover, if possible, the cause of the selection of these particular trees. "It is not easy to see," concludes Maclear, "the cause of selection, for these trees were not the most prominent, nor were they on the highest ground in the vicinity, the only feature the groups possessed in common being that they were all either near ditches which were full of running water, or else near temporary courses taken by the deluge of water from the higher to the lower ground."

Some statistics of the damage done by lightning stroke in Belgium⁶ in 1889 may be appropriately inserted here. Of 324 lightning flashes, 2 struck lightning rods; 128 struck buildings, setting 36 on fire; 16 struck persons; 96, trees; 81, telegraph and telephone lines; and others, miscellaneous. In other statistics we find that of 18 deaths due to lightning, 1 occurred within a dwelling, 11 out of doors, and 6 under trees. Contrasted with the cases of death resulting from lightning stroke, let us look at 43 cases of persons struck, with results not necessarily fatal, and we find that 20 of these were indoors, 23 out of doors, including 4 under trees. No records sufficiently extended and authentic are available to ascertain what proportion of persons struck by lightning are killed outright. I know of but one record, and in that of 212 persons struck 74 were killed. This question, which is of the greatest interest, is referred to again under the last of the rules given further on for the protection of life.

One of the peculiar and most common characteristics of the action of lightning is the *tearing off* or *throwing* effect. This, as we shall see further on, is just what might be expected from discharges of great frequency of alternation. Some interesting statistics are given by Parnell⁸ on the mechanical tearing off and disruptive effects of lightning and distinguished even from the *heat* effects. He records 1,147 cases. Of these, 224 do not permit a determination of the character of the work done by the stroke of the remaining 923.

	Mechanical work.	Heat.
Persons and animals.....	52	79
Cloths, carpets, canvas, woolen, linen, and cotton goods.....	88	79
Masonry of all kinds.....	416	2
Glass, china, earthenware.....	88	5
Metal.....	206	173
Wood.....	254	98
Trees.....	63	4
Ground.....	60	.....
Thatch, straw, etc.....	.....	11
Gunpowder.....	.....	15
Gas.....	.....	19
Total.....	1,221	485

Col. Parnell gives, furthermore, the details in 278 cases to show the existence of an *upward* direction in the force of the stroke.

This, and the statement that "probably few persons are aware that lightning strokes are more apt to bend or break metal than to fuse it," are, in the light of the investigations of the past three years into the character of the lightning flash, easily comprehensible. A lightning flash being a break in the air (i. e., the dielectric) when the electrical strain exceeds a certain value, determined by several variables, the strongest mechanical effect may be found in any direction, upward or downward. Speaking popularly, flashes may go from cloud to earth, earth to cloud, or from cloud to cloud to earth.

ELECTRIC LIGHTING CONSOLIDATION AT OTTAWA, CANADA.

The three electric lighting companies heretofore doing business in Ottawa as the Chaudiere Electric Light & Power Co., the Standard Electric Co. and the Ottawa Electric Light Co. have joined hands, forming a new company called "The Ottawa Electric Company." The new board of directors is as follows:—T. Ahern, president; Hon. E. H. Bronson, vice-president; William Scott, J. W. McRae, C. B. Powell, G. P. Brophy, Geo. H. Perley, Francis Clemow, Robert Blackburn. The secretary-treasurer is Geo. S. MacFarlane; general superintendent, A. A. Dion. The Company has the contract for lighting the city of Ottawa for ten years. It has an installation of about 850 arc lights of 2,000 candle-power and 40,000 incandescents, mostly on the meter system. It has one of the finest water power stations in the country and a 1,200 h. p. steam plant used as an auxiliary and reserve.

5. "Quart. Journ. Met. Soc." 1890, p. 229.

6. Italics mine.

7. Evrard and Lambotte. *Ciel et Terre*. 1891; No. 7.

8. "Quart. Journ. Met. Soc.," Vol. vi, 1885. See also Col. Parnell's book.

4. Also, Appendix E. "Report of Lightning Rod Conference."

THE ELECTRICAL ENGINEER.

(INCORPORATED)
PUBLISHED EVERY WEDNESDAY AT
303 Broadway, New York.

Telephone: 3840 Cortlandt. Cable Address: LENGINEER.

GEO. M. PHILIPS, President. F. R. COLVIN, Treas. and Business Manager.

Edited by
T. COMMERFORD MARTIN AND JOSEPH WETZLER.
Associate Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—630 Atlantic Avenue,
Boston, Mass.

Western Editor and Manager C. KAMMEYER, 1439 Monadnock Building, Chicago,
Ill.

New York Representative, 303 Broadway, } W. F. HANKE.
Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada, - - - - - per annum, \$3.00
Four or more Copies, in Clubs (each) - - - - - 2.50
Great Britain and other Foreign Countries within the Postal Union " 5.00
Single Copies, - - - - - .10

[Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1898.]

EDITORIAL ANNOUNCEMENTS.

Addresses.—Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of THE ELECTRICAL ENGINEER. Communications for the attention of the editors should be addressed, EDITOR OF THE ELECTRICAL ENGINEER, 303 Broadway, New York City.

Communications suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.

VOL. XVIII. NEW YORK, AUGUST 29, 1894. No. 330.

CONTENTS.

EDITORIAL :—

	PAGE.
The Incentive of Ignorance.....	170
Electricity As A Fire Hazard.....	171
Rather Too Many.....	171
The Light of The Future.....	171
State Taxation.....	171

ARTICLES :—

Recent Observations On Earth Currents.....	W. FIRM. 161
Heating By Hot Wire Resistance (illustr.).....	A. S. HATCH. 163
The Olan Electric Current Recorder (illustr.).....	163
Magnetic Leakage in Dynamo-Electric Machinery.—II. (illustr.).....	A. E. WIENER. 163
The General Electric 200 Kilowatt Transformer (illustr.).....	165
Electricity as a Fire Hazard.—IX. (concluded).....	W. J. JEWEL. 167
Protection From Lightning.—I.....	ALEX. MCADIE. 168
The Equipment For Electrical Engineering Laboratories.....	PROF. D. C. JACKSON. 172

ELECTRIC TRANSPORTATION DEPARTMENT :—

The Three-Wire Trolley System at Bangor, Me. (illustr.).....	J. G. CARROLL. 166
Mr. Sachs on Conduit Railways.....	166

NEWS AND NOTES :—

Telegraphic Communication by Induction by Means of Coils.....	165
An Improvement in the Manufacture of Carbons.....	165
The Precipitation of Metals From Solution by an Electric Current.....	165
Lightning Protection for Ships 'n Dry Dock.....	165
Mollesan's Continuous Electric Furnace.....	166
Electric Lighting Consolidation At Ottawa, Canada.....	169
Sixteenth Annual Clambake At Providence, R. I.....	175
A Just System of Taxation.....	175
Color of the Electric Arc Light.....	175

LETTERS TO EDITOR :—

Street Lighting By Alternating Arcs.....	S. G. NEILER. 174
--	-------------------

SOCIETY AND CLUB NOTES :—

Society for the Promotion of Engineering Education.....	174
Forty-Third Meeting of the Am. Asso. Ad. Science.....	174

LITERATURE :—

"A Laboratory Manual of Physics And Applied Electricity."—Vol. I.....	174
---	-----

INVENTORS' RECORD :—

Classified Digest of U. S. Electrical Patents Issued Aug. 21, 1894.....	176
---	-----

TRADE NOTES AND NOVELTIES AND MECHANICAL DEPARTMENT :—

Hard Fibre Combine.—Newton Electric Co.—Miscellaneous Notes.....	175
Mr. Johan W. T. Olan (illustr.)—Mather Direct Connected Generators (illustr.)—Mather Sales.....	177
National Direct Current Dynamo (illustr.)—Reorganization by Queen & Co., Inc.—Inside Protection of Iron Roofs.—Gamewell Fire Alarm Tel. Co.—Incandescent Lighting Novelties.—Globe Carbon Works.....	178
United Electric Corporation.—Wood's Flexible Pole Bracket (illustr.)—Recent Work of The Ball Engine Co., Erie, Pa.—Cutter's Combination Windlass (illustr.)—Philadelphia Notes.....	179
The Wilson-Whiting-Davis Automatic Oiling System (illustr.).....	180
Western Notes.....	180

THE INCENTIVE OF IGNORANCE.

WE are so often treated to songs of praise on the triumphs of modern science and the worlds of truth it has opened out before us that it is refreshing to be reminded of the fact that, so far as concerns knowledge of the ultimate nature of many things of which people are apt to talk glibly, we know practically nothing. It is to this state of affairs that Lord Salisbury devotes his attention in his recent presidential address before the British Association Meeting just closed at Oxford. Coming from a member of that rapidly increasing class, who are especially prone to exercise their imaginations—the amateur scientists—it is all the more gratifying to note the exhibition of conservatism where it is much needed and least expected.

Of all the scientific enigmas still confronting us, Lord Salisbury considers as most notable, the nature and origin of the elements. Notwithstanding the brilliant investigations of Dalton, Mendeljeff, Kirchhoff and others, we are no nearer the solution of the problem, whether the atom of each element is a movement, or a thing, or a vortex, or a point having inertia; what are the limits of its divisibility; whether any of the elements have a common origin, etc.

Lord Salisbury next turns his attention to what is called the ether, which he boldly describes as "a half-discovered entity." He defends his use of the term entity under the plea that it would be a great exaggeration of our knowledge to speak of it as a body or even as a substance. Indeed Lord Salisbury goes so far as to assert that for more than two generations the main, if not the only, function of the word ether has been "to furnish a nominative case to the verb 'to undulate.'" While admitting the advances made in our conception of the ether by the work of Clerk Maxwell and Hertz, Lord Salisbury still insists that the mystery of the ether, though it has been made more fascinating by these discoveries remains even more inscrutable than before; all we still know of the ether is that it can be made to undulate. Whether, outside the influence of matter on the motion of its waves, ether has any effect on matter or matter upon it, is absolutely unknown; and even its solitary function of undulating, ether performs in an abnormal fashion which has caused infinite perplexity. Again, he asserts that it is not easy to fit in the theory of electrical ether waves with the phenomena of positive and negative electricity; and as to the true significance and cause of those counteracting and complementary forces to which we give the provisional names of positive and negative, we know about as much now as Franklin knew a century and a half ago.

We need not follow Lord Salisbury any further into the domains of biology and geology which he also enters to prove the indictment of ignorance, for there is, indeed, no department of science which he could not add to his list of witnesses.

It is hardly to be supposed that Lord Salisbury intended his admirable discourse to be taken literally for although much of what he says is true, yet it would be but small credit to modern science to maintain that it had brought us no nearer to the revelation of the great truths than we

were a hundred years ago. His intention, evidently, was rather to inspire renewed zeal than to criticise or belittle the labors and achievements of the past.

ELECTRICITY AS A FIRE HAZARD.

WITH this issue we bring to a close the admirable paper, by Mr. W. J. Jenks, on "Electricity as a Fire Hazard," which ought to be carefully studied by every one connected with the installation of electric lighting or power plant. We cannot but believe that the losses from fire, legitimately traceable to electric currents, have been due to the ignorance rather than the negligence of those in charge of such plants, and that if the true limitations of conductors carrying currents were better known, electrical fires would become a thing of the past. That electricity can be distributed safely is admitted even by the fire underwriters, but it took them a long time to make up their minds to the fact. While the fire underwriters may be looked upon in some quarters as enemies to electric lighting, we believe that all well informed and right thinking members of the electrical community are in accord with their efforts to secure proper electric installation; and while the insurance regulations may err on the side of safety, the public, after all, benefit thereby in the long run. As Mr. Jenks shows, the apparent excessive factor of safety called for by the underwriters' rules is demanded by reason of the fact that in many cases conductors are after a time called upon for service far in excess of that for which they were originally designed,—and this without any attempt at fraud or deception. It is too much to hope that complete immunity from electrical fires can be obtained, even under the best system of rules, but when the early and defective installations are finally remodeled it is safe to say that an electrical fire will be a rare occurrence. What is really now needed is that the various rules governing electrical installations should be brought to the point of harmony and uniformity. In some respects they now disagree and conflict, but there should be no trouble in making them support each other alike in letter and spirit. Such uniform rules would sound the death knell of bad work.

THE LIGHT OF THE FUTURE.

THE remarks made by Prof. Elihu Thomson at the entertainment provided for the members of the Association of Edison Illuminating Companies, during the recent meeting in Boston, coming from so high an authority, claim more than usual attention. Recognizing the irreconcilable properties of the incandescent lamp—long life and efficiency,—Prof. Thomson is led to the conclusion that little, if any, improvement is to be hoped for in the economy of electrical illumination by incandescence with the present type of lamp. He believes that it will require some radical departure, some invention or discovery, to bring about a material gain in the economy of electric illumination, and that such an advance is hardly to be looked for in the near future. It follows from this that electric lighting companies need not be seriously alarmed for the security of their present investments, through their impairment by the displacement of methods at present in use. Without desiring to put into Prof. Thomson's mouth words not

uttered by him, the conclusion which one irresistibly arrives at is, that he views the latest results in electric illumination, namely, those shown in the illumination of vacuum bulbs by alternating currents of high frequency and high potential, as scarcely yet affording a solution of the problem. In this view it must be admitted Prof. Thomson does not stand alone. We must not lose sight of the fact, however, that it is but a comparatively short time since Mr. Tesla pointed out the possibilities in this field, and that the paths indicated by him are being diligently pursued by many able workers. In this connection we need hardly recall the fact that for many years before Edison's success, experimenters had been at work on the problem of making a commercial incandescent lamp, and that achievement was reached notwithstanding the adverse opinion of many competent authorities. It is not to be assumed, therefore, that success in high frequency lighting should be immediately attained. No one, we think,—certainly not Prof. Thomson—would be rash enough to assert that further attempts in vacuum glow lighting are futile. Pending the possible practical outcome of this method of lighting, the gains of the near future, as pointed out by Prof. Thomson, will be those due to good engineering, pure and simple,—and that alone may well claim the attention of the best talent for many years to come.

RATHER TOO MANY.

IN our issue of August 8, commenting upon Mr. S. M. Hamill's article on arc lighting in the *Engineering Magazine* we quoted doubtfully from that article the statement that the new factory of the National Carbon Co. was rated at a capacity of 2,500,000,000 carbons per year. Mr. Hamill informs us that some one between his pen and the typesetter added an extra naught, multiplying his figures by ten, and that the error was not discovered in proofreading. As most of the readers of THE ELECTRICAL ENGINEER are good at mental arithmetic they have doubtless corrected the figures for themselves. Mr. Hamill gives the capacity of the National factory at a little over 20,000,000, per month, or 250,000,000, per year; more than the world's present consumption. The new factory will start up at less than half this rate of production.

STATE TAXATION.

IN another column we print, from the *Journal of Commerce*, a letter by Mr. Allen R. Foote, including an article on taxation suggested for the consideration of the Constitutional Convention now in session at Albany. We commend Mr. Foote's proposed article to the attention of all electrical companies, in this State particularly, and believe it would be worth while for all of them to address their representatives in the Convention, asking their careful examination of the plan. A provision substantially similar to that offered by Mr. Foote, would certainly tend to bring about more simplicity and directness, as well as equity, of taxation at once, and would leave the way open for the gradual elimination of all complexity. Indeed it would permit the application of a "single tax," should that method of raising revenue eventually acquire general approval.

THE EQUIPMENT FOR ELECTRICAL ENGINEERING LABORATORIES.¹

BY PROF. D. C. JACKSON.

When this subject was assigned to me by your Secretary it was suggested that a discussion of the ideal equipment for the electrical engineering laboratories of engineering schools was not wanted. The discussion should be limited to the special electrical equipment that is necessary for use in engineering schools having a course in electrical engineering, in order that proper instruction may be given in their specialty to the undergraduate electrical engineering students. This seems to be a reasonable limitation, and in fact an essential one, if the discussion is to be of value. I doubt if any one is able, with our present knowledge of the requirements, to outline the true ideal equipment for electrical engineering laboratories. We can all tell what we now consider an ideal equipment, but in a few years it may be far from ideal. We are, however, faced by a positive condition which demands a first-class working equipment in the electrical engineering laboratories. *How can the electrical laboratory equipment be made most effective, is a question for solution; how much and what equipment is required to fulfill the demand in the instruction is another question which confronts us.*

As we are dealing with *electrical engineering* laboratories, we will assume that they are attached to an engineering department over which a professor of electrical engineering presides. The electrical engineering department is therefore separated entirely from the physics department, and is coordinate with the other departments of engineering. The practice, at present common in many colleges, of placing the electrical engineering course with its class room and laboratory instruction under the direction of the professor of physics is just as absurd as it would be to devolve upon that professor the instruction in advanced thermodynamics and the design and construction of steam engines. It is equally absurd for the professor of electrical engineering to attempt to teach physics. Proper instruction in physics is essential to the student who is pursuing a course in electrical engineering, and the physics department must be well controlled and supplied with an excellent independent laboratory equipment. In addition to the ordinary general course in physics the electrical engineering student should gain, during his course in physics, a common sense grasp of the elementary notions of electricity and magnetism and of the "all pervading law of Ohm." The latter can be properly enforced in the laboratory by placing in the student's hands ordinary electrical instruments, such as galvanometers, bridges, voltmeters, amperemeters, voltmeters, etc. Before beginning his work in *electrical engineering*, the student's knowledge of Ohm's law and its common results should have become almost instinctive. The student should also become acquainted with the theory and practice of photometry. This should all be done in the physics department and the equipment required for the instruction should be controlled by that department. Much of this equipment is quite different from that required by the electrical engineering department, but some of it is useful to both departments and where students are not too numerous may be used to some degree in common.

With due regard for his preparation, it seems best to arrange the professional electrical studies for the average electrical engineering student in four divisions, in three of which laboratory work must be made an integral part of the instruction in a satisfactory course. The divisions are:—

1st. Electromagnetism and its applications to special uses, with special reference to dynamos and motors.

2nd. Electrochemistry (including primary and secondary batteries) and electrometallurgy.

3rd. Alternating currents and alternating current machinery, including alternators, transformers, motors, condensers, etc.

4th. The special applications of the preceding divisions in electric light, power, railway, mining, telegraph, telephone and other types of plants. These divisions are of about equal real moment, but the last must be allotted more time in the lecture room than either of the others; but little or no laboratory time or equipment need be directly allotted to it. The laboratory equipment for the first three divisions only need, therefore, be discussed. The equipment that can be made useful in the fourth division is usually of an illustrative nature and must be a matter of slow growth and collection as the electrical industries progress, rather than of immediate selection.

While higher mathematics is a useful aid in each of the divisions, its limitations as an agent must be carefully shown in the class room and laboratory. For the purpose of educating the judgment of a student and fully defining the limitations of theories and mathematical deductions, the laboratory is indispensable and the equipment should be selected with this object in continual view. The equipment should be so selected and be of sufficient amount, that as much as one half of the total time spent by the student under the direct instruction of the professors of electrical engineering may be profitably devoted to the laboratory. The

equipment, moreover, should be such that the work may, as far as possible, deal with fixed commercial instruments and machinery, and actually follow the methods of testing and research used in practice. The first three divisions should each be properly represented by a commercial laboratory equipment, in which every principle and operation is illustrated and made useful in every-day instruction under the direction of a man who has had experience in similar commercial work after having had a thorough theoretical training in preparation for his work. The laboratory work must always go hand in hand with the class-room work, illustrating and strengthening the latter. *In this way the equipment may be made most effective in the work for which it is designed.*

We will call the laboratory equipments for the three divisions, the dynamo equipment, the electrolysis equipment, the alternating current equipment, and consider the essential features of each separately, in the consecutive order given, since that is probably the best order for the student to take them up. It is well to remember at this point that engineering measurements are almost invariably *quantitative*, and that the results from an engineering investigation which bear fruit are also nearly always *quantitative*. It is seldom that purely qualitative results may be accepted as satisfactory in engineering work. Therefore the laboratory equipment must be capable of doing quantitative work which is in general of satisfactory commercial accuracy, and which may be made rigorously exact for purposes of exact investigation.

The first work that a student should take up upon entering the dynamo laboratory is a study of the methods of testing the magnetic qualities of iron. In this work testing by magnetometer, ballistic galvanometer, and traction should be used. The apparatus for the magnetometric method is very simple and is generally at hand, as almost any reflecting galvanometer may be used for the magnetometer. For the ballistic method a magnetizing yoke and proper test pieces should be supplied as well as a satisfactory galvanometer. Arrangements for determining the constant of the galvanometer and proper current measuring instruments must be supplied. For the latter, Weston amperemeters with proper scales and in good condition are entirely satisfactory. To determine the constant of the galvanometer several methods requiring their own special but simple apparatus should be used. The special apparatus for the traction method of testing iron, consists simply of a magnetizing yoke with its test pieces. Here again an amperemeter is required. Indeed a good supply of first class amperemeters and voltmeters is of the utmost importance in the electrical laboratory. These should be selected so that various types are represented, but for general use with continuous currents the Weston instruments are most satisfactory and should therefore be in a majority. Amperemeters with scales from 0 to 1, 0 to 5, 0 to 15 and 0 to 50; voltmeters with scales from 0 to 5, 0 to 60, 0 to 150, 0 to 600; and milliamperemeters and millivoltmeters are indispensable. The actual number of instruments required for use must depend of course upon the number of students who work in the laboratory.

In addition to the standard methods of testing iron which have been mentioned, there are several special devices constructed by different instrument makers, which are of some advantage in instruction but which should not be purchased until all the essential equipment is supplied. Such are the iron tester using a bismuth spiral made by Hartmann & Braun, the Siemens & Halske device, and magnetic bridge arrangements.

It is not a bad plan to have various test pieces for use with the ballistic method made from cast and wrought iron and cast steel, of known chemical composition and degrees of annealing. These may be most conveniently in the form of bars to be used with the magnetizing yoke, or may be rings. By using various specimens for the class testing a very good idea of the differences to be found in different bars is given to the students. In this work the student should always be required to plot both the curve of magnetization and the permeability curve of his specimen, as well as to fully report his process.

After the testing for simple magnetic quality comes the measurement of the hysteresis loss and its companion, coercive force. For this purpose apparatus for the magnetometric method with slowly varied continuous currents should be provided. This may be similar to the apparatus for the magnetometric method of testing the magnetic quality of iron. If a sufficiently small number of students work in the laboratory, the same apparatus may be used. In addition to the magnetometric apparatus a couple of devices for testing hysteresis loss by alternating currents should be supplied. These methods are being improved so rapidly that it is impossible to say which are the best for fixed use in laboratory instruction, and much must be left to individual choice. Here again are various excellent illustrative but unessential pieces of apparatus, such as the Ewing curve tracer, which should only be purchased after the essential apparatus is fully supplied, or which really belong in the field of the department of physics.

The writer makes all his laboratory work follow quite closely to his class room instruction, and therefore makes the work in the dynamo laboratory follow the plan of his text book on Electromagnetism and Continuous Current Dynamos. Consequently,

1. A paper read before the Society for the Promotion of Engineering Education, Brooklyn, N. Y., Aug. 22, 1904.

after the students have completed their work in magnetic testing, they begin a study of the dynamo. The dynamo room must fulfill two objects: 1st, To furnish current for experimental work which cannot be conveniently furnished from the laboratory lighting circuits; 2nd, To supply machines for laboratory testing. For the first purpose dynamos of various pressures driven by a steady power must be arranged so that they may be operated upon laboratory circuits as desired. This requires that a good automatic engine which is used for no other purpose be used to drive the dynamos, and that the machines be systematically wired to suitable distributing switch boards. A good storage battery of 60 or 70 cells is a most useful adjunct in this connection. For the second purpose, it is desirable to have continuous current machines of comparatively small size—from 2 to 10 kilowatts capacity. Such machines are readily handled, are not readily injured, when injured are inexpensive to repair, and laboratory testing with the machines under load is always possible while it would frequently not be so with larger machines. A dynamo laboratory in which a fair number of students work needs a number of such machines, which should be carefully chosen to represent the widest range of types and styles of construction. All these machines should be so arranged that they may be operated either as dynamos driven from a constant speed prime mover, or as electric motors.

Upon entering the dynamo room for work the student receives systematic instruction in handling the dynamos so that his work may proceed without danger to himself or to the machines. Determinations of the strength of the fields of dynamos when the armature windings are known are then made from measured speeds and pressures. This requires no instruments except voltmeters and ordinary speed counters. Following this comes the measurement of leakage by ballistic methods, and a comparison of the measured results with results calculated from the dimensions of the machines. This gives the student an idea of the *large percentage of guess* which must enter into such calculations. Tests of the magnetic circuits of dynamos, the regulation of dynamos and motors with different forms of field windings, effect of load on lead, characteristic curves, etc., all require the all-useful amperemeters, voltmeters, and speed counters, which as already said must be on hand in sufficient number and with a sufficient variety of range.

Efficiency testing requires a more varied equipment, yet in this the amperemeter and voltmeter hold prominent places. In stray power tests and determinations of the losses by hysteresis and Foucault currents in armature cores, amperemeters, voltmeters, and speed counters supply all the information that is needed. Efficiency tests should always be made by stray power, live load, and dead load methods. For the latter, convenient variable liquid, wire, and lamp loads should be liberally supplied. One or more first-class bridges must be at hand for measuring resistances, and standard instruments, such as Kelvin balances or Weston laboratory instruments, should be conveniently arranged for the calibration of the portable instruments. Stationary devices for the measurements of currents, such as a good calorimeter and a galvanometer arranged for use in the so-called Vienna method, should be properly mounted.

Recapitulating, the essential apparatus for the dynamo laboratory is:

Appliances for testing the magnetic and hysteretic-qualities of irons, together with the necessary test pieces, galvanometers (plain and ballistic), standard solenoids, earth coil, condenser, etc.

Set of small continuous current dynamos and motors representing various types for laboratory testing.

Goodly supply of first-class amperemeters and voltmeters, of various types, with standards for use in calculation.

Instruments for measuring currents by different methods, bridges and special instruments for measuring resistances.

Various arrangements for loading dynamos and motors, and testing their speed.

A number of portable storage cells to furnish steady currents which cannot be conveniently supplied from the lighting circuits and the dynamo room.

The electrolysis and alternating current equipments will not be taken up in so great detail. The former requires for the fundamental work a number of standard cells, silver and copper voltmeters, fine galvanometers, balances for weighing, accurate resistance boxes, devices for measuring the resistance and specific inductive capacity of electrolytes. For the advanced work is required a goodly supply of primary and secondary cells of various types which may be used in examination and testing, and a well equipped set of two or three good-sized electro-deposition vats and arrangements for heating by the arc, with low-pressure dynamos, and the amperemeters, voltmeters, and hydrometers which are necessary to carry out work on a considerable scale in electro-deposition and electrometallurgy. The electrolysis laboratory has received comparatively little attention in American engineering schools, but its importance makes it deserve the allotment of its full share of equipment and instructional force. There seems to be a time coming when the electrolysis equipment will be made equal in importance to the dynamo equipment in all first-class engineering schools.

The alternating current is receiving a preponderating amount

of attention in many colleges, sometimes on account of the numerous striking and beautiful experiments which may be performed by the alternating current, and sometimes because of the attractive field of speculation which is opened by the use of poly-phase currents in power transmission. It is not belittling the enormous value of the alternating current to say that the equipment of each of the divisions should be given equal consideration, and no one should be given undue prominence to the injury of the others.

The effects of self-inductance, mutual inductance and capacity are at the root of a large proportion of alternating current phenomena, and the fundamental alternating current equipment should be arranged for the study and measurement of inductances. It would be a long step in advance if electrical engineering graduates were given as lively and practical a working conception of inductance and reactance as that usually given them of Ohm's law and its results. For studying inductances in the laboratory various coreless solenoids are needed which may be used for experimental and mathematical determinations of the coefficients. The methods of measuring the inductances of solenoids should include the direct measurement of self-inductances by amperemeter and voltmeter, using an alternating current of known frequency, the comparison of self-inductances with each other and with mutual-inductances, the direct measurement of mutual-inductances by amperemeter and ballistic galvanometer, the comparison of self and mutual-inductances with capacities, etc. After these measurements have been carried out by the student, using the simplest known methods, the measurements should be extended to include circuits with iron cores. These measurements require comparatively simple apparatus, but it should be on hand in sufficient amount. Carefully wound long and short solenoids of known constants, condensers of known capacity, bridges, alternating current amperemeters and voltmeters, a sensitive ballistic galvanometer and a secohmmeter are essential for the work. A very convenient instrument for use in this branch of the work is a variable standard inductance, but its place may be filled by solenoids of known constants.

After inductances, the alternator and single-phase currents are in logical line. One or more small alternators are needed for this work, which may be carried out in much the same way as that relating to continuous current dynamos. The work, however, requires the introduction of two new instruments, the wattmeter and a device for taking alternating current curves. Wattmeters are difficult instruments to get in satisfactory form, but probably the Weston form is the best for general laboratory use, though a split-dynamometer is a good instrument to have at hand. There is a considerable number of schemes for the tracing of alternating current and pressure curves, and more than one should be put into use. The relations of the current and pressure waves in circuits should be studied from the curves, as well as from measurements of the true and apparent energy in the circuits. This study is finally applied to transformers, a number of which, representing various types of construction, should be in the equipment.

The laboratory equipment to be supplied for the study of poly-phase current effects is as yet an open question. It seems desirable to have at hand polyphase currents of variable frequency, and induction motors representing the different types of construction. The variable frequency polyphase currents may be most readily gained by means of a rotary converter.

The equipment which has been enumerated, or is necessary to carry out the experiments that have been mentioned, covers the *essential requirements of any first class undergraduate course* in electrical engineering. There is much more work which must be carried out in the laboratory, such as testing the insulation resistance of wires, measuring the earth's magnetic force, accurately comparing standard resistances by divided wire bridge, etc., etc., but the equipment for this is found in that already enumerated or has its place amongst the apparatus of a well equipped physics department. There is much apparatus which is entirely unnecessary for both the physics and electrical engineering departments to possess. In fact, the work just mentioned, with the exception of insulation testing, really belongs in the instruction given by the professor of physics, and as intimated earlier it is well for the laboratories to be quite independent of each other. There is a vast amount of work carried on by undergraduates in the preparation of theses which is often in the nature of excellent investigation. Some of this requires special apparatus, and the extent to which it should be supplied from laboratory funds is an open question. Where the investigation does not require special apparatus, or where the work is in the nature of a test of commercial apparatus or an operating plant, the equipment that is required will nearly always be found amongst that supplied for the regular course, if the latter has been properly designed.

In determining the course of study to be pursued by the electrical engineering undergraduate, upon which the course of laboratory work must depend, it must unfortunately be remembered that he cannot confine his attention to electrical engineering during the whole time given to professional work in his course. He must gain an elementary but practical knowledge of thermodynamics and hydraulics, with an efficient knowledge of their application in steam and water power plants. He must also

get a *common sense knowledge* of the principles underlying the design, manufacture, and selection of machinery. In fact, he must receive a good working knowledge of the problems of the mechanical engineer. Laboratory courses are likely to fail when not properly balanced, on account of a failure to *educate the common sense or judgment* of students, and the students leave the college without having gained an all-round *capacity for practical work and research* which is necessary to put them in a fair way to become useful engineers. The knowledge of the electrical engineer must be based on the honest, well tried mechanical laws, and he must go into a study of all that will aid most in putting him in the way to make a thorough electrical engineer.

LETTERS TO THE EDITOR.

STREET LIGHTING BY ALTERNATING ARCS.

I have noticed the letter in your issue of Aug. 15, in reference to "Street Lighting by Alternating Arcs," signed by Hon. Wm. F. Cody (?), and, to say the least, I was considerably amused at the attempt to throw a slight upon the article written by Mr. R. E. Richardson and myself. In our article we said nothing whatever against the general adoption of alternating arc lamps, excepting as Mr. Armstrong proposed to use them in connection with his ideal plant and system of distribution.

I have not the remotest idea what point the writer was driving at in referring to our statement that "to avoid argument, we would agree that, under certain conditions, there might be a saving in cost of conductors in favor of the alternating system, but such conditions would naturally be special cases." Mr. Armstrong's article assumed an ideal plant, and without question special conditions were necessarily imposed which were not practicable to adopt, and in our communication we took up this particular point and showed, I hope, where his deductions were incorrect, as well as endeavored to bring out clearly the point where it would be of advantage to use such a system, particularly in connection with existing incandescent alternating plants, and I am glad to note that your correspondent agrees with us that Mr. Armstrong did make a number of misleading statements.

To quote from the letter: "They next state that because of an arc lamp being constructed under broad patents, it would not be admissible." This is ludicrous in the extreme, as one will readily see, by a perusal of our article, exactly to what reference was made.

The most amusing part of your correspondent's letter is the statement that "they do not state what they cut in when they cut out,"—referring to the operation of the automatic cut-out in a series arc lamp. The poor fellow must be sadly deficient in his knowledge of the interior mechanism of a series arc lamp. Does he think we would have a resistance to cut in series with the lamp, or, as I would infer from what he writes further on, that we would place an automatic cut-out on a pole?

I am sorry indeed that "Buffalo William" should see anything misleading in our statement that "careless linemen often put in copper wire for fuses." No reference was made to copper wire fuses at all, but to copper wire such as linemen are ever apt to use.

I cannot see wherein taking two men to reply, as noted in the first part of the letter, has any bearing on the question at issue, and cannot find that any point has been brought forward wherein we were wrong in the least in our deductions.

After reading over the letter, I was not at all surprised that your correspondent preferred not to sign his name, but instead, should use the nom de plume of "Buffalo Bill," thereby adding a "Wild West Show" to what I cannot help looking at as a very deplorable composition for the enlightenment of the electrical fraternity, particularly in regard to cut-outs. I had at first thought of communicating with the Hon. Wm. F. Cody and asking him when he had taken up the electrical (?) business in preference to that money-making show of his, but as the authorship of the article seemed apparent, I decided to offer my thanks directly for a few moments of amusement such as I have not experienced for many moons.

SAML. G. NEILER.

CHICAGO, ILL., Aug. 18, 1894.

SOCIETY AND CLUB NOTES.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION.

This society met at the Polytechnic Institute in Brooklyn on August 20 to 22 inclusive. The officers are: President, De Volson Wood, Stevens Institute, Hoboken; vice-presidents, S. B. Christy, Berkeley, Cal.; Geo. F. Swain, Mass. Institute Tech., Boston; secretary, J. B. Johnson, Washington University, St. Louis; treasurer, Storm Bull, Wis. State University, Madison.

Addresses were made, and papers read, by well known engineers and professors of engineering, relating to the best methods of disseminating engineering instruction, with reference to text books, lectures, laboratory and field work. The only paper

devoted distinctively to electrical work was one by Prof. Dugald C. Jackson, of the University of Wisconsin, on "Electrical Engineering Laboratories," which appears elsewhere in this issue.

FORTY-THIRD MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE American Association for the Advancement of Science, held its 43rd meeting at the Polytechnic and Packer Institutes in Brooklyn on Aug. 15 to 24 inclusive. The papers read included a wide variety of subjects, classified under the following general heads:

A.—Mathematics and Astronomy; B.—Physics; C.—Chemistry; D.—Mechanical Science and Engineering; E.—Geology and Geography; F.—Zoology; G.—Botany; H.—Anthropology; I.—Economic Science and Statistics.

It will be noticed that electricity is not mentioned in this list, and but little attention was given to it. Such electrical papers as there were came under the head of "Physics" and were as follows: On the Directed Velocity of the Particles in the Electric Arc, by Benj. W. Snow; The Influence of Heat and Electricity upon Young's Modulus for a Piano Wire, by Mary C. Noyer; On Magnetic Potential, by Frederick Bedell; On Electric Strength, by Geo. W. Pierce; A Phonographic Method for Recording the Alternating Current Curve, by C. J. Rolleson; On Some Magnetic Characteristics of Iridium, by S. H. Brackett; Lightning as a Case of the Dissipation of Energy, by N. D. C. Hodges; Some Peculiar Lightning Flashes, by Alexander McAdie.

The meetings were well attended, 477 members being present, while 213 new names were added to the list. Besides the sessions for business and the reading of papers, a number of excursions were made to near-by points of interest.

The following officers were elected for the ensuing year:

President, E. W. Morley, Cleveland, O.; vice-presidents for the several sections: A.—E. S. Holden, Mt. Hamilton, Cal.; B.—W. LeConte Stevens, Troy, N. Y.; C.—William McMurtrie, Brooklyn, N. Y.; D.—Wm. Kent, Passaic, N. J.; E.—Jed. Hotchkiss, Staunton, Va.; F.—D. S. Jordan, Palo Alto, Cal.; G.—J. C. Arthur, Lafayette, Ind.; H.—F. H. Cushing, Washington, D. C.; I.—B. E. Fernow, Washington, D. C.; permanent secretary, F. W. Putnam, Cambridge, Mass.; general secretary, Jas. Lewis Howe, Louisville, Ky.; secretary of the council, Charles R. Barnes, Madison, Wis.; secretaries of the sections: A.—E. H. Moore, Chicago, Ill.; B.—E. Merritt, Ithaca, N. Y.; C.—W. P. Mason, Troy, N. Y.; D.—H. S. Jacoby, Ithaca, N. Y.; E.—J. Perrin Smith, Palo Alto, Cal.; F.—S. A. Forbes, Champaign, Ill.; G.—B. T. Galloway, Washington, D. C.; H.—Anita Newcombe McGee, Washington, D. C.; I.—E. A. Ross, Palo Alto, Cal.; treasurer, R. S. Woodward, New York, N. Y.

Among the Fellows elected were Dr. Frederick Bedell, of Cornell University; Prof. W. H. Bristol, of Stevens Inst. Tech.; Mr. Nelson H. Genung, of Ardmore, Pa.; Prof. M. W. Harrington, Chief of the U. S. Weather Bureau; Prof. S. T. Moreland, of Lexington, Va.; and Dr. Samuel Sheldon, of the Brooklyn Polytechnic Institute.

LITERATURE.

A *Laboratory Manual of Physics and Applied Electricity*. Arranged and edited by Professor Edward L. Nichols. Two Volumes. Volume I.: Junior Course in General Physics. By Ernest Merritt and Frederick J. Rogers. New York, 1894. Macmillan & Company. 294 pp. 5½ x 9 in. Price, \$8.

THE necessity for thorough laboratory work in the teaching of the physical sciences is now so thoroughly recognized that our colleges and universities are at the present time devoting more time and expending more money in the equipment of physical laboratories than has been done at any previous period in the history of education in this country. It is one thing, however, to possess a physical laboratory and another to know how to get the best results out of it. In other words, without a systematic employment of the facilities at hand the results accomplished may be very meagre. Electrical laboratories, especially, have been the subject of much attention during the past few years, and on the average American colleges are probably as well equipped as, if not better than, those abroad.

The volume before us is intended as a guide to laboratory work and is the first of two intended to take the student through a course adapted to the junior grade in our colleges. It does not profess to be an all-embracing manual, but has in view the reference, by the student, to original authorities and to larger treatises on special subjects. The manual is designed for three classes of students differing from each other in experience, maturity and purpose, and while the first volume is intended for beginners, the last will grant the student great freedom in methods and leave him almost entirely free from the close supervision of the instructor.

The experiments are divided into groups, and include the experimental demonstration of the main principles and phenomena

in the domain of physics. Of the twelve chapters in this volume seven are devoted to magnetism and electricity. The plan adopted is to give first a clear statement of the principle or phenomenon to be investigated, and then the directions for carrying out the experiment. The mathematics employed are well within the grasp of those having some knowledge of analytical geometry and calculus. The illustrations are admirably clear and will be found a great aid to the student in his work.

We can heartily recommend the work, not only to students, but to teachers as well.

COLOR OF THE ELECTRIC ARC LIGHT.

PROF. J. A. FLEMING has shown that the well-known color of the light of the electric arc from carbon points is due to the incandescence of the carbon filling the space between the positive and the negative rods. The true arc is here, and exists in a space filled with the vapor of carbon, which has a brilliant violet color. Thus, in a sense, the arc light is mainly an incandescent light, the effect being produced by the layer of carbon which is being constantly evaporated at an extremely elevated temperature. Hence the light of the carbon arc is not, and can never be, white, as it is sometimes described as being, but must always be tinted violet by the carbon vapor normally present between the rods.

A JUST SYSTEM OF TAXATION.

[From the *Journal of Commerce and Commercial Bulletin*—August 27.]

A SUGGESTION FOR THE CONSTITUTIONAL CONVENTION—IMPORTANT TO THE INDUSTRIAL, COMMERCIAL AND FINANCIAL INTERESTS OF THIS STATE.

Editor "*Journal of Commerce and Commercial Bulletin*":

The power of an unjust system of taxation to drive business out of a city or State, or of more favorable conditions to attract business to a State, is illustrated by the well defined tendency of corporations to evade the laws of the State of New York and to take advantage of the laws of the State of New Jersey.

I have given much thought to the tax systems of several States, and therefore regard with great interest the work of the Constitutional Convention on this subject. The revision of the Constitution affords the citizens of New York an opportunity to base their tax system on sound economic principles, which will assure the State and the commercial centre of the nation a position of commanding advantage in the worldwide competition for commercial supremacy. Full advantage should be taken of this opportunity, not only for the direct benefit of the citizens of the State, but also to furnish an example for other States whose citizens rightly look to New York for guidance in sound industrial, commercial and financial policies.

After spending several weeks in studying the proposals made and debates upon the questions of taxation and public-service corporations as they have been developed before the Convention. I have suggested to several members of the Convention the following article to be incorporated in the new Constitution on the subject of taxation:

Section 1. All taxes shall be assessed on property. All property shall be assessed for taxation at its full value in current funds, and shall be entered on the assessment list in the tax district in which it is located, in the name of the owner, manager, agent or person having the property in charge.

Section 2. The rate per cent. of the tax levied on valuation for any tax shall be uniform for all classes of property within the same tax district, so that all property shall be taxed equally. This section shall not prohibit the assessment and levy of special taxes for special benefits from public improvements.

Section 3. Tax bills shall be a lien upon property and may be sold as provided by law.

Section 4. Property shall not be taxed in any way other than as provided in this article, except for special benefits from public improvements. Tax assessments shall be made but once in the same year. Charges shall not be made by State, municipal or other authorities intrusted with the exercise of the power of taxation in any manner, except a property tax, for the right or privilege of engaging in any industry or business unless it be for the purpose of regulation to protect the morals or the health of the people.

Section 5. Evidence of ownership, indebtedness or credits not being property shall not be taxed, but the payment of a tax bill by the person in whose name it is made shall be a payment upon any mortgage, deed of trust, contract or other form of evidence by which a debt or a credit is secured, for the same proportionate amount of the tax bill as such security bears to the assessed value of the property affected by it.

Section 6. The Legislature may exempt the whole of any class of property from taxation, but it shall not make any partial exemption by authorizing a decrease of the rate per cent. of a tax levy for one or more classes of property less than the unexempted whole, or for a part of a class, nor shall it exempt a part of the property of any class.

Section 7. Bills for taxes shall be made in the name of the owner, manager, agent or person having the property in charge, as entered on the assessment list, and the payment of the same shall be a legal payment for the full amount of the tax bill of any debt or obligation of any kind due from such person to the true owner of the property upon which the assessment was made.

A measure of this importance demands most careful consideration. Judging from what I find before the Convention on this subject, I believe a measure of this character will be most willingly adopted, especially if the constituents of each member lose no time in impressing him with the desirability that such action shall be taken.

As my interest in the question is purely that of an economist,

I shall be very glad to have any person send me any suggestion intended to make this measure more just, accurate in purpose, or less complicated.

ALLEN R. FOOTE.

24 Dove Street, Albany, N. Y., Aug. 24, 1894.

THE SIXTEENTH ANNUAL CLAMBAKE AT PROVIDENCE, R. I.

THE sixteenth annual gathering of the electrical fraternity as guests of the American Electrical Works at a genuine Rhode Island "Clambake" has come and gone and was not one whit less enjoyable than its fifteen predecessors. As on the two previous occasions, last Saturday's picnic took place in the picturesque grounds of the Union Club, at lovely Haute Rive, on the Providence river. Nearly two hundred guests responded to the invitations. The day was delightfully fine—typical "Phillips' weather," as was more than once remarked—bright and breezy throughout, so that everyone had comfort and fun in taking a hand at the games and amusements so liberally provided. Most of the picnickers traveled to the rendezvous from Providence per electric cars, and on reaching their objective point promptly proceeded to make short, sharp and destructive war on the lunch awaiting them. Then "Bake" hats had to be fitted on bald and hairy pates alike, soon alas! to be pounded and demolished by the persistent blows of the ubiquitous foot-ball, that invariably furnishes more fun in the lunch room than on the lawn. No time was lost in organizing a base-ball game between Providence and Boston. When the game was called the score stood: Boston, 26; Providence, 6. (It was not always thus in former years.) Meantime, the orchestra discoursed lively music until the arrival of the photographer. Then came the call to dinner. It took but a few moments for all to get seated and make the attack on the many toothsome dishes enumerated on the dainty menu, which was an artistic production in ancient Egyptian papyrus and hieroglyphics, to aid in unraveling the mysteries of which by the uninitiated an electrically insulated tee-totum was presented to each guest, the spinning of which was found not only to speedily unlock the Egyptian mysteries, but aided digestion as well.

Mr. Eugene F. Phillips presided at the head of the centre table, being supported on his right by Mr. Charles W. Price as toastmaster, and on his left by his bosom friend, Mr. John S. Sabin, of San Francisco. Incidentally it may be stated that Mr. Sabin was the friend who first suggested the idea of these clam-bakes to Mr. Phillips.

Speeches were then made by Hon. J. C. Wyman, of Providence; Eugene Phillips, J. S. Sabin, Angus Hibbard and Frank Ridlon. The festivities concluded in the usual happy fashion.

THE NEWTON ELECTRIC COMPANY.

The Newton Electric Company, manufacturers of electrical specialties, with offices at 89 and 41 Cortland street, New York City, have issued a neat and well printed catalogue containing descriptions and illustrations of some of the more important of their novelties. Several new appliances are now in course of construction and will be described in other circulars from time to time, as they are ready to put before the public.

HARD FIBRE COMBINE.

It is reported that the fibre companies are about to consolidate. As in many other trades close competition during the past two years or more has put prices below a point at which no satisfactory profit can be made, and the fibre people seem about to try their hand at combination.

FREDERICK B. COREY has recently opened an office in the Hathaway Building, Boston, as consulting electrical engineer and expert, making a specialty of the designing of electrical machinery and apparatus.

THE Akron and Cuyahoga Falls Rapid Transit Co. are in the market for two or three closed car bodies one of which will probably be with part of one end arranged for transporting mail, express and baggage. Address, Thomas F. Walsh, Manager, Akron, Ohio, or W. E. Hall, Hamilton, Ohio.

SINCE the fire which destroyed their works, the Siemens & Halske Electric Company have closed six contracts for various classes of machinery, of which the two most important are the Hotel Savoy, New York, for a large lighting plant, and Franklin MacVeagh & Co., in Chicago, for a power transmission plant.

THE AMERICAN BELL TELEPHONE COMPANY has filed a return showing that it spent about \$50,000 to secure the legislation authorizing it to increase its capital up to \$50,000,000. Its special counsel got a fee of about \$7,500 apiece, and about \$13,000 was paid to the Boston papers for printing the arguments of Messrs. Long and Morse, made before a legislative committee.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED AUGUST 21, 1894.

Accumulators:—

Method of Producing Electrodes, D. G. Fitz-Gerald, London, Eng., 534,710. Filed Nov. 7, 1893.

The method consists in treating litharge with a solution of caustic potash, converting the caustic alkali into carbonated alkali by exposure to carbonic acid, and treating the resulting mass with sulphate of magnesia.
Separator for Battery Plates, W. L. Silvey, Dayton, Ohio, 524,843. Filed Feb. 12, 1894.

Alarms and Signals:—

Fire Alarm System, J. W. White, Providence, R. I., 524,973. Filed May 23, 1894.

Comprises a closed circuit containing a resistance, an open circuit containing a translating device, a thermostat with three electrodes, two of which close a shunt around the resistance while the third closes the open circuit.
Electric Danger Signal for Railways, A. B. Murray, San Rafael, Cal., 524,947. Filed March 17, 1893.

A system of automatic, electric signaling for the protection of railway trains near points of danger.
Electric Railway Signal, L. Dornberger, Highland Falls, N. Y., 524,738. Filed April 17, 1894.

An electric semaphore signal for steam railways.

Conductors, Conduits and Insulators:—

Electric Wire Coupling, C. K. Hall and W. B. Lillard, New Orleans, La., 524,980. Filed Dec. 8, 1893.

A coupling designed especially for use between cars, and similar in its application to the coupling of an air brake pipe.
Underground Conduit for Electrical Conductors, J. F. Cummings, Detroit, Mich., 524,977. Filed Jan. 17, 1893.

Consists of a series of tubes divided longitudinally and arranged with their ends overlapping and held together by a spirally wound binder.

Insulator, C. N. Hammond, Boston, Mass., 524,850. Filed Dec. 12, 1893.

Distribution:—

Apparatus for Transforming Continuous Electric Currents into Alternating Currents, F. S. F. Schneider, Fulda, Germany, 524,911. Filed Mch. 20, 1894.

Employs two electro magnets in two primary circuits, a battery common to both circuits, a rocking armature alternately making and breaking the circuits, and a secondary conductor having its terminals connected with the primary circuits between the magnet and the circuit breaker.
Electrical Subway System, J. C. Reilly, Brooklyn, N. Y., 524,789. Filed May 28, 1891.

Relates to a system of subways for supplying any subscriber with temporary or permanent connection without disturbing the main conductors.
System of Electrical Distribution, G. Westinghouse, Jr., Pittsburgh, Pa., 524,749. Filed June 16, 1890.

Has for its object to so organize a system that some of the converters may be cut out of and into the circuit as required.

Dynamos and Motors:—

Commutator for Dynamo Electric Machines, G. F. Card, Covington, Ky., 524,884. Filed Jan. 8, 1894.

Employs cap plates mounted on the armature shaft and carrying a series of segments, and a packing interposed between the plates.

Motor Generator, J. C. Henry, Westfield, N. J., 524,852. Filed Dec. 18, 1891.

Claim 1 follows:—

In an electro-magnetic machine, the combination of suitable fields, two armatures revolving in relation thereto, and flexible shafting mechanically coupling the shafts of said armatures.

Automatic Regulator for Dynamos, H. D. Symmes, St. Catharines, Canada, 524,845. Filed June 6, 1894.

Consists of solenoids in the main circuit and resistance circuits with contacts therein arranged as a shunt to the main circuit, each solenoid being adapted to break contact with the corresponding resistance circuit when a current of more than a pre-determined quantity passes through the main circuit.

Commutator Cylinder, A. J. Shaw, Muskegon, Mich., 524,793. Filed June 7, 1894.

Provides for compensating for the expansion and contraction of commutator bars.

Galvanic and Thermo-Electric Batteries:—

Apparatus for Supplying Electricity for Light and Power Purposes, M. M. Kohn, Chicago, Ill., 524,983. Filed Sept. 24, 1891.

A system of producing light and power by the use of primary batteries and employing an apparatus for controlling the generation and use of the current.

Heating:—

Electric Heater, T. W. Young, Washington, D. C., 524,881. Filed Oct. 4, 1893.

An electric heater for oil wells designed to melt the hardened paraffine in the fissures of the rock and remove such obstructions to the flow of the oil.

Lamps and Appurtenances:—

Electric Arc Lamp, R. H. Jahr, Opladen, Germany, 524,981. Filed April 19, 1894.

Employs a horse shoe magnet with an armature placed between the poles and capable of oscillating in a horizontal plane; a winding placed in the main circuit to excite one of the poles and another winding in a derived circuit exciting the other pole.

Electric Light Support, W. H. Connell, Wilmington, Del., 524,706. Filed Jan. 24, 1891.

Measurement:—

Electric Meter, C. D. Rabb, Kaiserslautern, Germany, 524,953. Filed Jan. 18, 1894.

Employs a revolving armature having coils in a shunt, damping discs adjacent to the armature, stationary coils and conductors and mica discs interposed between the armature and the damping disc.

Miscellaneous:—

Tank or Cell for Electrolytic Purposes, F. E. & A. S. Elmore, Leeds, Eng., 524,940. Filed Nov. 25, 1892.

Consists of an outer and an inner wooden box separated by a canvas jacket and a packing of plastic bituminous composition.

Railways and Appliances:—

Electric Railway Supply System, J. F. Cummings, Detroit, Mich., 521,956. Filed Sept. 22, 1892.

Employs two insulated supply conductors, two distributing conductors whose sections are independently connected by feeders to the main conductors, an independent source of electricity having one terminal connected to

a movable contact of a switch at the central station and the other to the ground and an indicating device in the circuit.

Electric Railway Car, J. C. Henry, Westfield, N. J., 524,823. Filed Aug. 27, 1892.

Relates especially to the suspension of the motor.

Controller for Electric Cars, M. B. Monroe, New Orleans, La., 524,735. Filed Feb. 23, 1894.

Employs a rheostat with vertical contact plates and a vertically movable plunger connected with the brake mechanism and moving over the contact plates as the brake is applied.

Electric Railway Supply System, M. Wheelless, Washington, D. C., 524,773. Filed July 7, 1894.

Employs a sectional underground conductor in combination with contacts arranged at intervals and a contact shoe carried by the car.

Switches and Cut-Outs:—

Electrical Testing Switch, H. Smith, Buffalo, N. Y., 524,844. Filed March 29, 1894.

Consists of a compact arrangement of binding posts, contact buttons and switch lever enabling the operator to ground the circuit at either side of the station or to cut out the latter entirely.

Circuit Controller, E. J. McEvoy, New York, 524,808. Filed July 7, 1894.

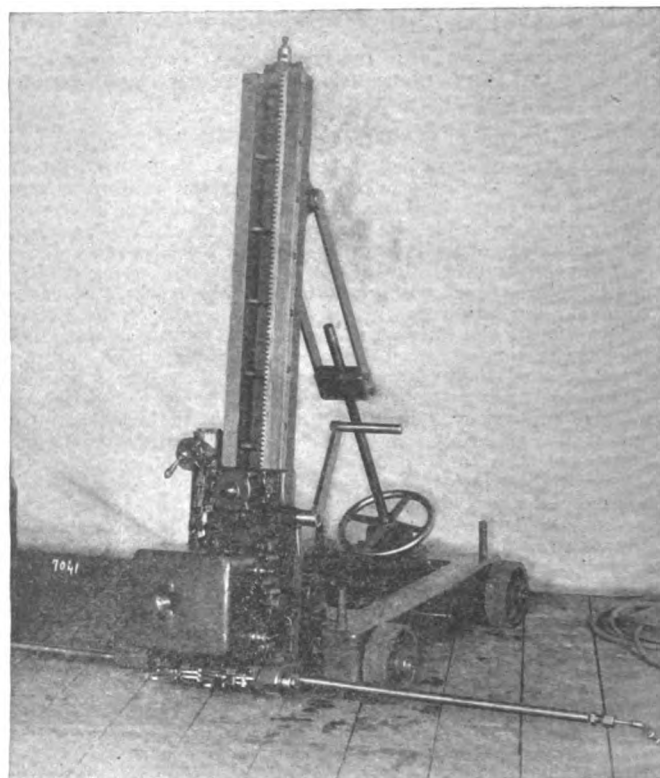
Safety Switch for High Potential Circuits, S. Harris, Cleveland, O., 524,717. Filed June 14, 1894.

Telegraph:—

Printing Telegraph, R. A. Fowden, Philadelphia, Pa., 524,711. Filed Dec. 22, 1893.

GENERAL ELECTRIC GADDER DIAMOND DRILL.

AN ingenious adaptation to quarrying by electricity is the electric gadder diamond drill, recently put out by the General Electric Company. This machine, of 2 K. W. capacity, possesses



GENERAL ELECTRIC GADDER DIAMOND DRILL.

the advantages which should be inseparable from all machinery of this class, durability and simplicity. It is a machine of very few parts. The table on which the actuating mechanism rests can be inclined at any angle with the floor, and allows a travel of seven feet parallel to its face. In addition the drill can be so lowered as to drill within two inches of the rock bed, and by a change in the driving and feed nut gears, the automatic feed may be adjusted to the nature of the rock. The motor is provided with a reversing switch, which with a proper arrangement of gears makes it possible to cut into a corner in either direction, by reversing the feed screw in the feed device, that is, the gadder can cut either to its right or left side. The importance of this feature lies in the fact that it has been obtained by no other gadder drill without the use of complicated reversing gearing. It is provided with a quick return mechanism. While cutting into the rock the drill is fed slowly; in marble the speed is about one foot per minute; when it has reached the desired depth it can be given a quick back-feed by the simple movement of a lever.

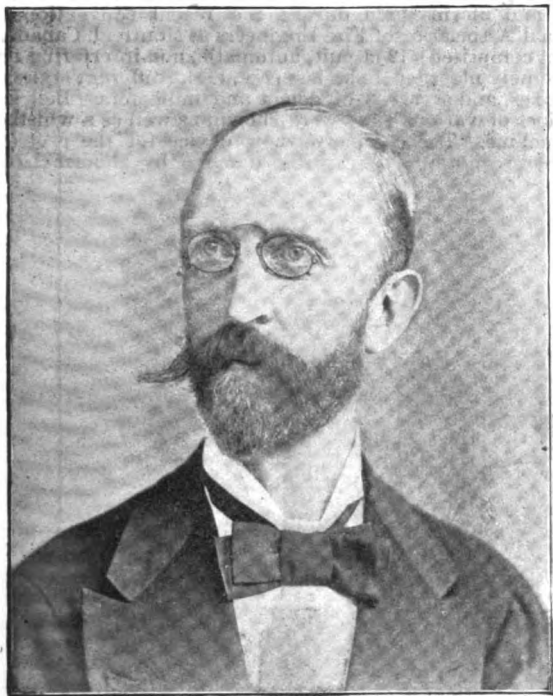
The motor is of the iron-clad, waterproof and dust-tight type, which has proved its durability under the most adverse circumstances. The end thrust of the feed screw in both directions is taken by the ball thrust bearings. The drill rod can be made of any reasonable length up to about twelve feet.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

MR. JOHAN W. T. OLAN.

MR. JOHAN W. T. OLÁN, who has spent the last four years in this country, devoting himself to electrical inventions, was born in Sweden. After four years of training at the elementary pub-



JOHAN W. T. OLAN.

lic school, and seven years spent in classical study at the High School at Gothenburg, he entered in 1875 the philosophical faculty of the University of Upsala. Pursuing studies in mathematics, natural sciences and languages, he went later to the south of Europe where he studied at the University in Geneva,

Paris and in various other places. Returning to Sweden, he finished his studies at the Polytechnicum in Stockholm and adopted mining engineering as his profession. Mr. Olán took an active part in the decoration of the Swedish section of the International Electrical Exhibition in Paris 1881. He entered Mr. Edison's service and worked at the International Electrical Exhibition in London in 1881 and 1882. Securing a contract with the Edison Foreign Electric Light Co. he went to Sweden in 1882 as superintending electrical engineer to do the pioneer work for the incandescent light in that country, and remained there until the Edison patent was annulled by the Swedish Government.

An interesting patent of Mr. Olán's will be found described and illustrated elsewhere in this issue. The Swedish American Engineering and Art Co., of 254 Washington street, Jersey City, has been formed to introduce the device.

MATHER DIRECT-CONNECTED GENERATORS.

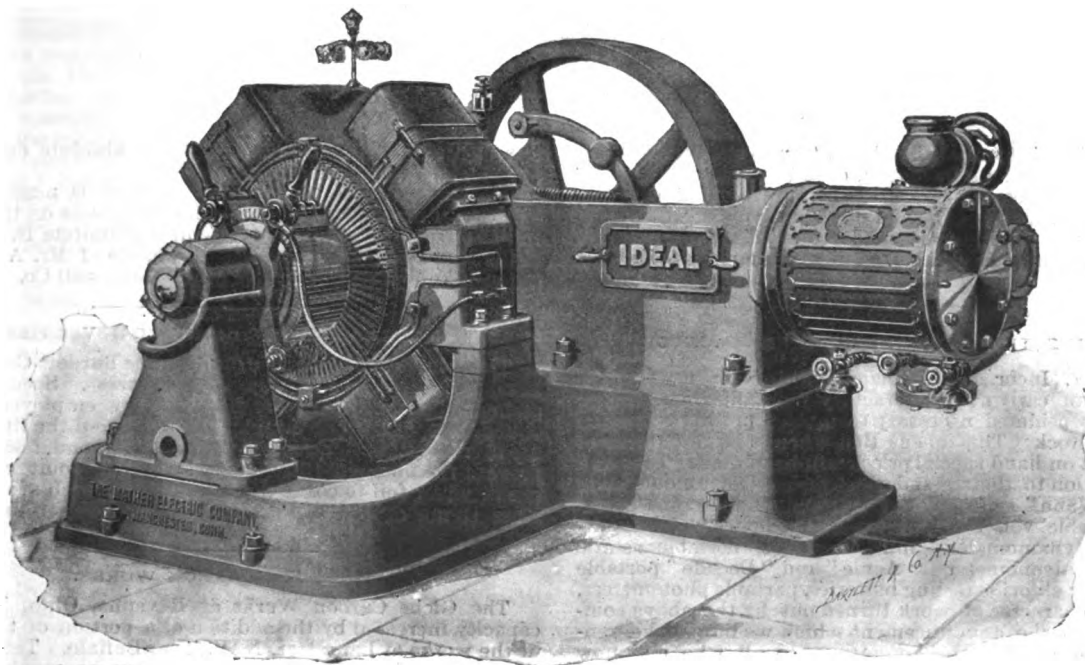
The direct-connected generators manufactured by The Mather Electric Company are the result of years of experience, both in this country and abroad, and embody advanced ideas in design and construction in this class of apparatus. The accompanying illustration shows one of the generators in combination with an ideal engine.

They are designed, however, to be directly connected to any first-class type of engine adapted for this work, and are exceedingly compact. They are self-oiling, self-exciting, perfectly self-regulating, and, after being started, completely self-attendant.

It is also claimed that they can be operated for an indefinite period at their full rated capacity without any undue or dangerous heating of any of the parts.

The field and armature being practically identical with those of the company's standard multipolar generators, they have been able to design testing frames, upon which they can set up and run every generator, before shipping, under conditions similar to those it is intended to meet in actual practice, and no machine is allowed to leave the factory unless meeting all requirements as to its mechanical and electrical perfection.

THE MATHER ELECTRIC COMPANY, of Manchester, Conn., report the closing of an important contract with the Phelps Publishing Company, of Springfield, Mass., publishers of *The Springfield Homestead*, *The American Agriculturist*, *The Farm and Home*, etc., for the complete equipment of their extensive plant with electric power. The new slow-speed motors of the Mather Company will be used throughout, in sizes from 20 to 50 H. P., the power being supplied from the Springfield station of The United Electric Light Company. This installation, when completed, will be one of the largest of its kind in New England. The Mather Company are now represented on the Pacific Coast by the following contractors for their apparatus: H. B. Gregory & Co., Portland, Oregon; The Will & Finck Co., San Francisco, Cal.; The Machinery Supply Co., Los Angeles, Cal.



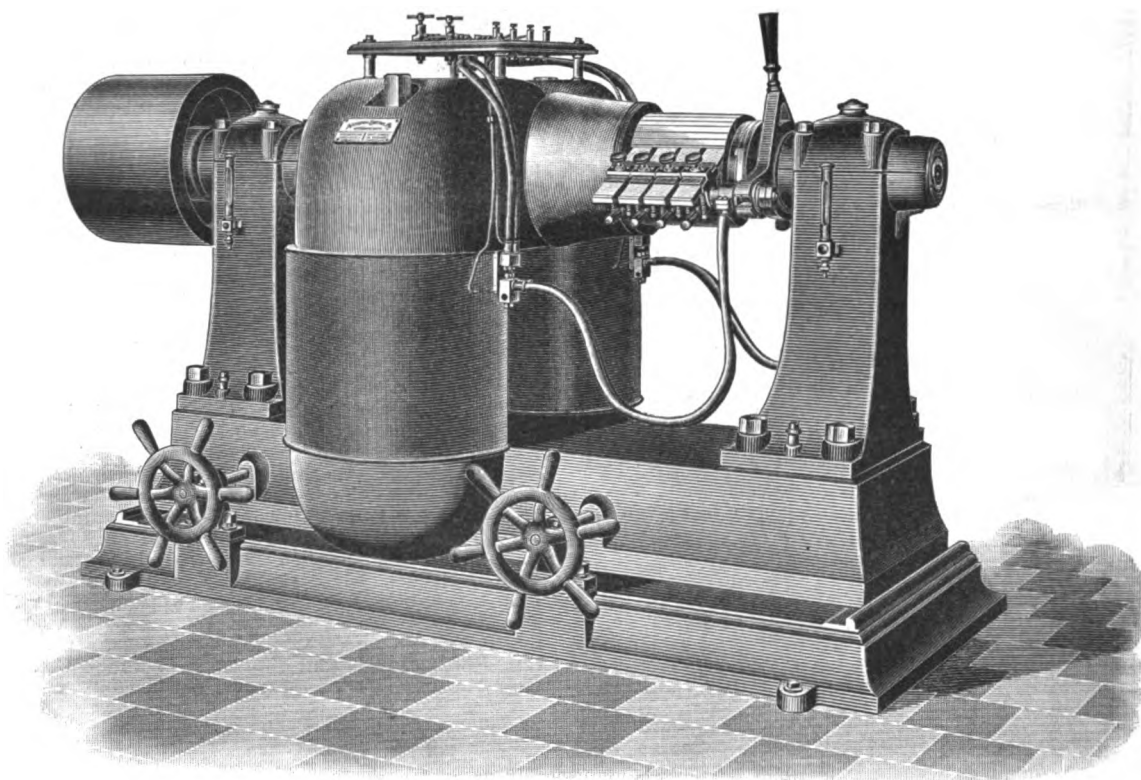
MATHER DIRECT-CONNECTED GENERATOR.

THE NATIONAL DIRECT CURRENT DYNAMO.

The accompanying illustration shows a 50 k. w. direct current generator built by the National Electric Company, of Eau Claire, Wis. The machine is compact and substantial, with regular outlines. It is mounted upon a heavy cast iron base, and is provided with convenient and easily operated shifting-screws for tightening the driving belt. The base and bearing supports are of liberal proportions. The bearings of the machine are of the ring, self-oiling type, and are also self-aligning. The armature shaft is of ample size to secure stiffness as well as strength; and is turned from a high grade of forged steel, which insures good wearing qualities.

The armature is adjusted to perfect rotative balance, and runs free from straining actions. It is also balanced magnetically in a longitudinal direction, being held in the proper position by the action of the field without the use of collars on the shaft.

National machines are built with armatures of the standard drum type. The cores are built up of thin steel discs, insulated, keyed to the shaft, and clamped rigidly in position. The work of insulation about the armature is thoroughly performed. There are no less than five layers of selected insulating materials—including oil-paper, linen, ducking, mica, etc.—between the core and conductors. The entire winding is stayed and wedged with



NATIONAL DIRECT CURRENT DYNAMO.

fibre strips, and it is firmly banded at intervals not greater than an inch and a quarter along its length, each band being composed of several wraps of phosphor bronze spring wire soldered together. Thus, the winding constitutes a solid unyielding mass.

All parts of the machine are made to standard gauges and templates, and are interchangeable. The workmanship is finished throughout.

"REORGANIZATION SALE" BY QUEEN & CO., INCOR.

QUEEN & Co., Incor., of Philadelphia inform us that in order to effect an early and satisfactory reorganization of their company, it is considered necessary to make a prompt reduction in merchandise stock. This means that where a large number of a given article is on hand special prices will be quoted. They call particular attention to their standard electrical instruments such as "Magnetic Vane" switch-board volt and ammeters, Deprez-Carpentier portable volt and ammeters, Cardew standard voltmeters, electro-dynamometers, milli-ammeters, portable astatic and D'Arsonval galvanometers, "Acme" and "Decade" portable testing sets, silver chloride testing batteries, portable photometers, etc. The high character of work turned out by the above company in addition to the announcement which we now make, renders the matter of considerable importance to all who may now or in the near future have any need for instruments of the classes named.

INSIDE PROTECTION OF IRON ROOFS.

THE BERLIN IRON BRIDGE Co., of East Berlin, Conn., have received the contract from the Delaware, Lackawanna and Western R. R., for one of their patent anti-condensation corrugated iron roofs, to cover the new engine room at the Auchincloss shaft. This is the third roof of this kind that the Delaware, Lackawanna and Western Railroad people have bought of the Berlin Company, showing the merits of this system of protecting the corrugated iron on the underside from dripping.

GAMEWELL FIRE ALARM TELEGRAPH CO.

THE GAMEWELL FIRE ALARM TELEGRAPH Co. had a large and interesting exhibit of its apparatus at the exhibition of fire appliances and alarms held during the recent convention of the National Association of Fire Engineers at Montreal, Canada. The exhibit comprised a 12-circuit, automatic, non-interfering repeater handsomely mounted in a glass case, eight different styles of signal boxes, and a variety of gongs and indicators. Bell striking machines of various sizes were shown, as well as a whistle blowing machine. The company's new device for the protection of the electrical apparatus against damage by abnormal currents

was also exhibited. This device is an absolute cut-out, so that damage to the apparatus is impossible.

The excellence of the Gamewell system is manifest from the fact that it is used by over 600 cities and towns on this continent, and also from the number of attempts to imitate it. The exhibit at the Montreal convention was in charge of Mr. A. D. Wheeler, the well-known representative of the Gamewell Co.

INCANDESCENT LIGHTING NOVELTIES.

The installation of electric lights in the Burdett-Coutts mansion, London, is described in the English press. Specially designed and cut-glass shades of candle shape are employed in the large chandeliers, and other cut-glass fittings; and the lines of cutting are carried either horizontally or else diamond fashion, so as to prevent the filament being seen. Another point consists in the use of silver foil to cover the lamp wires which are led along the glass stems of the fittings in such a manner as to be hardly visible.

GLOBE CARBON WORKS.

The Globe Carbon Works at Ravenna, Ohio, is to have its capacity increased by the addition of a portion of the machinery of the works at Lancaster, N. Y., near Buffalo. This will increase the output about 20,000 carbons a day or making up a total capacity of nearly 75,000 daily.

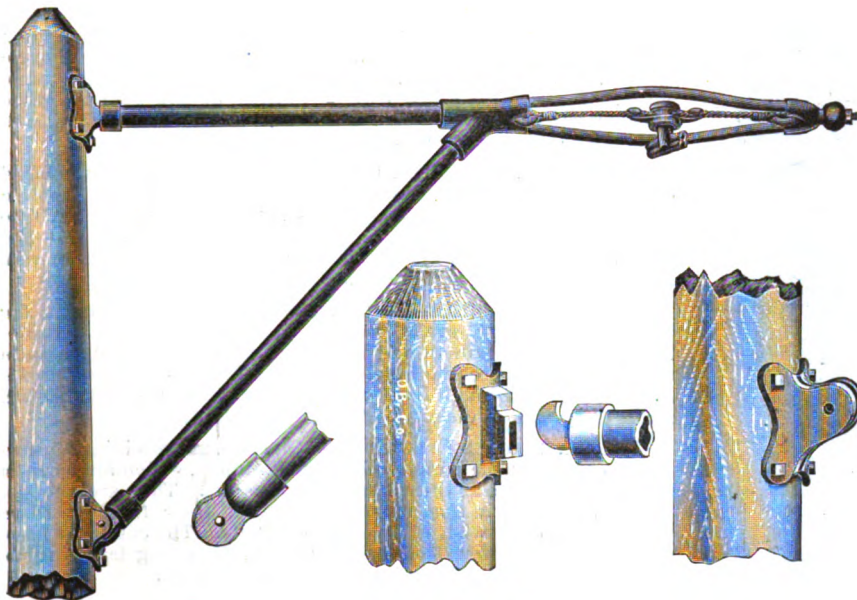
UNITED ELECTRIC CORPORATION.

The United Electric Corporation, of 811 New York Life Bldg., Minneapolis, Minn., takes pleasure in introducing itself. The company is incorporated under the laws of Minnesota and the charter provides for manufacturing and dealing in all kinds of electrical machinery and appliances. For the present it will confine its operations to telephones and telephone supplies. The company is well organized and starts out under most favorable auspices, having the necessary sinews of war—capital and talent—at its disposal.

The officers are Samuel Grant, president; J. H. Finney, vice-president; G. R. Kibbe, secretary and treasurer, and P. W. Bossart, manager. Mr. Grant is a prominent capitalist in the Northwest, while Mr. Bossart is a favorably and widely known electrician and a pioneer in the telephone business.

WOOD'S FLEXIBLE POLE BRACKET.

THE Wood's flexible pole bracket manufactured by the Ohio Brass Co., of Mansfield, Ohio, and shown in the accompanying illustration, is designed to overcome the hammering effect of the trolley wheel on the hanger, due to the rigid construction ordinarily used on the regular pole bracket. It provides a yielding and flexible support allowing the cars to be operated at a high rate of speed without the evil results often experienced. It is



WOOD'S FLEXIBLE POLE BRACKET.

claimed to combine the best features of the cross and bracket suspensions. The peculiar construction of the upper pole socket and hook allows the bracket to be easily swung into position and admits of adjusting the horizontal arm vertically. The straight line hanger is suspended between the curved arms on a steel strand cable, the tension of which can be adjusted by means of an eye bolt at the end of the bracket. The maximum spread of the curved arm is 6 inches and the distance between the centres in which the cable is suspended is 2 feet. The fittings for this bracket are made of malleable castings to insure greater strength, and the most careful workmanship is noticeable throughout.

RECENT WORK OF THE BALL ENGINE CO., ERIE, PA.

THE SHOPS of the Ball Engine Co., Erie, Pa., present a scene of activity in spite of the unfavorable condition of trade generally, and are running full time. There have been shipped from the Works lately the following:

Edison Elec. Light & Power Co., Erie, Pa., 1 850 H. P. Vertical Compound engine; Edison Elec. Light & Power Co., Erie, Pa., 1 800 H. P. Cross-Compound; Eureka Light Co., Eureka, Cal., 1 800 H. P.; Industrial Home of the Blind, Chicago, 1 80 H. P.; J. H. Houghton, Boston, Mass., 1 50 H. P.; Minneapolis General Electric Co., Minneapolis, Minn., 1 35 H. P.; Bronx Gas & Electric Light Co., Van Nest, N. Y., 1 250 H. P. Tandem Compound; Bronx Gas & Electric Light Co., Van Nest, N. Y., 1 250 H. P. Tandem Compound; Hotel Newcombe, Quincy, Ill., 1 60 H. P.; Gen. A. S. Bushnell Building, Springfield, O., 1 60 H. P.; Lexington Electric Light Co., Lexington, N. C., 1 50 H. P.; Greenwich Gas & Elec. Light Co., Greenwich, Ct., 1 150 H. P.; Greenwich Gas & Elec. Light Co., Greenwich, Ct., 1 125 H. P.; Kennard House Co., Cleveland,

O., 1 50 H. P.; City of Griffin, Griffin, Ga., 1 185 H. P.; Howe Pump & Engine Co., Ladd, Ill., 1 50 H. P.; Sykes & Wagner, Minneapolis, Minn., 1 80 H. P.; F. F. Vater & Co., Minneapolis, Minn., 1 35 H. P.; Risdon Iron Works, San Francisco, Cal., 1 150 H. P.; Electric Supply & Engineering Co., Detroit, Mich., 1 70 H. P.

CUTTER'S COMBINATION WINDLASS.

The gain in leverage makes a geared windlass popular with trimmers for raising lamps, but the difference in cost over that of a plain windlass has counted against a more wide-spread use of the former. The extra price being due to the cost of the gearing, the only feasible way for reducing it would consist in making one pinion do for a score or more of the devices. This is what has been done in the new form shown in the accompanying illustration, which consists of a geared windlass with a detachable pinion, the latter together with its bearing box being secured to the portable handle. The bearing box fits into a recess in the windlass frame and is easily locked in place by the hinged catch, thus making a geared device. What is more, the pinion itself is hollowed out to



CUTTER'S COMBINATION WINDLASS.

fit the shaft of the hoisting drum, so that the same handle will do in using the device as a plain windlass.

The pinion handle with the bearing box is made as light as possible, so as to be easily carried by the trimmer and the result is a practical geared windlass at a price within the reach of all plant owners.

The device is manufactured by George Cutter of Chicago.

PHILADELPHIA NOTES.

THE ELECTRICAL SIGN of the "Six Little Tailors" that has been attracting the attention of so many passers on Chestnut St., was installed by Harry S. Smith & Co., Ltd., who expect to install several more in the near future.

HARRY S. SMITH & Co., LTD., have been awarded the contract for two 45 K. W. Mather multipolar dynamos for the Bartram Apartments, 33rd St. and Woodlawn Ave., Philadelphia. These machines will be direct connected to Woodbury engines. The Falkenau Engineering Co. will do the balance of the electrical construction work in the building.

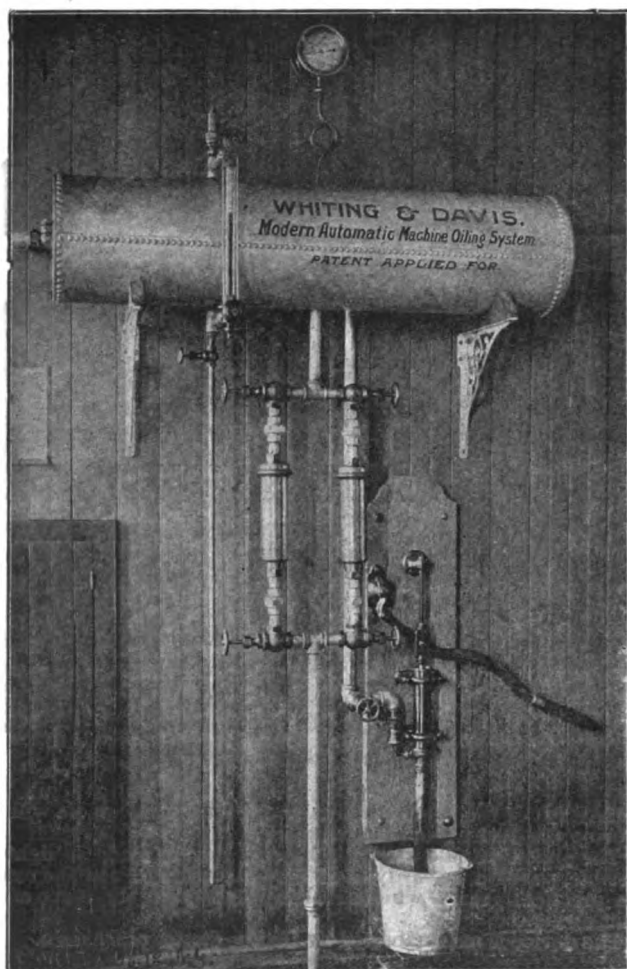
HARRY S. SMITH & Co., LTD., have completed the wiring of the buildings of the State Hospital for the Insane, at Wernersville, Pa., the work comprising everything from the dynamos to the lamps, there being 8,000 lamps and a number of ventilating sets in the buildings. The Chapel Building which contains a stage and has a large seating capacity is fitted with all the latest improvements for electrical stage effects, with foots, border lights, etc., controlled by individual rheostats.

THE WILSON-WHITING-DAVIS AUTOMATIC OILING SYSTEM.

An interesting system of automatically oiling machinery, has recently been devised and introduced by the Wilson-Whiting-Davis Oiling Company, whose head offices are in the Mutual Reserve Building, in this city.

The application of the system insures the oiling of machinery in a positive and automatic manner, under a pressure sufficient to overcome all obstacles ordinarily encountered, and does away with all the manual labor required where hand-fed cups are used. At the same time a large saving of oil, varying from 20 per cent. to 40 per cent. is claimed. The oil comes to the bearings perfectly clean, and the waste, which is very small in amount, can if required, be returned to the reservoir by gravity pipe system. The wear and tear on machinery, due to careless oiling, is also entirely avoided.

The cups are of brass (nickel plated if desired) and each is controlled by a separate valve and may be adjusted by screw at top,



WILSON-WHITING-DAVIS AUTOMATIC OILING SYSTEM.

so as to exactly regulate the feed, while permitting the instant flooding of any bearing if required. Each branch of piping and each separate machine is also controlled by a separate valve; hence, when a machine is idle only the one valve requires closing and all cups on its line cease feeding.

The accompanying illustration shows the complete apparatus required to operate the system. This consists of an iron tank, into which the oil is pumped. Pressure, to an amount depending upon the requirements of the plant, is then applied to the tank by the same pump (which is shown near the floor line), forcing the oil through the filters below the tank, into the main line of piping, thence through concealed branches to the different machines and cups. The inlet and outlet pipes to tank are also controlled by valves as already mentioned. When the number of cups exceed 125, or machinery is on different levels, an automatic compressor is provided to further insure the constancy of the pressure.

Two filters are provided on the main supply pipe in case one needs repairs or cleansing. This main outlet, inside the tank, extends several inches above the bottom, to prevent the entrance of any foreign substance into the main feed lines. When the

gauge indicates the presence of such substances or water, they may be drawn off by the sediment cock and branch shown below the tank. The tank may be placed at any point in engine or oil room, and the gauge and register may be on the wall in sight of the engineer and the pump lever convenient to his hand. The variation in pressure, due to the gradual emptying of the tank, is said to be so slight as to demand but a minute or so of attention, twice a day.

WESTERN NOTES.

MR. GEORGE W. FURBECK, the well-known contractor of Chicago, has a ten years franchise for operating arc and incandescent lamps and telephones at South Haven, Mich. Work has already been commenced on the plant and Mr. Furbeck is in the market for the necessary apparatus.

THE OHIO VALLEY ELECTRICAL ENGINEERING CO., of Cincinnati, O., has been employed to construct a fire and police alarm system for the beautiful suburban city of Clifton, adjoining Cincinnati. Mr. T. F. Clohesy is the electrical engineer of the Ohio Co., which has its headquarters in the Johnston Building.

AMONG the recently incorporated companies in Illinois are the following:

Robertson Insulated Conduit Electric Co. at Chicago, capital stock, \$1,000,000; incorporators, J. Luttrell Murphy, Smith H. Bracey, Hamilton B. McMillan, Bernis W. Sherman, William O. Osgood and Charles A. Dy.

THE CHICAGO & NORTHWESTERN RAILWAY, Chicago, have just contracted for the complete installation of a telephone exchange system, by means of which all their local business is to be transacted. The central office will be located in the general office building and contain about a hundred "subscribers." The Bell Telephone Co.'s apparatus will be used.

THE UNION BRASS MFG. CO. is the name of the consolidated Chicago Nickel Works, the Reimann Co. and the Mosher Electric Co., all of Chicago. The president is Mr. Adolph Weinberg, late of the Adams & Westlake Co. and the headquarters are at the corner of Ontario and Franklin streets. The new concern will make electric lamps and hardware specialties.

THE ELECTRICAL APPLIANCE COMPANY report the demand for their Parante high grade wire to be steadily on the increase. Aside from the merits of the insulation it is the only high grade rubber-covered wire manufactured in the West, which leads to its support partly through local pride and also from the fact that all kinds of special orders can be furnished promptly.

THE WASHINGTON ELECTRIC CO., Chicago, are receiving a number of orders for their improved stage dimmers, which are built on the same principle as their Imperial Rheostats. They are meeting with much favor in theatres on account of their freedom from noise when used with alternating currents. The company have received an order for 15 of their 8,000 c. p. focussing lamps to be used in the Schenley Park fountains at Pittsburgh.

FISHER & PORTER, 1025 Monadnock Block, Chicago, report that they have just installed two 80 H. P. "M. A. Green" engines in the Leland Hotel, where they are running two National dynamos for incandescent lighting. They have sold one 150 H. P. "M. A. Green" engine to the Freeport Electric Co., of Freeport, Ill., for electric street railway work, and one 300 H. P. "Improved Greene" engine to the Hammond, Whiting and East Chicago Electric R. R. Co., at East Chicago, Ind. Messrs. Fisher & Porter are Western Representatives of the Altoona Mfg. Co., building the "M. A. Green" engine, and of the Providence Steam Engine Co., building the "Improved Greene" engine, and report that the works of both companies are running full time, and that they see prospects ahead for a good business.

THE GILLILAND TELEPHONE COMPANY, of Chicago, are meeting with good success in the introduction of their telephone. The instrument is made in a substantial manner and is artistic in form, consisting of magneto mounted on back-board with desk, bipolar magneto transmitter, and telephone receiver with cord, and is sold outright at a fair price. Their central office and exchange system for towns and small cities is complete and comprehensive. The president, Mr. W. H. McKinlock, and the general manager, Mr. J. J. Nate, have spent the greater portion of their lives in telephone and kindred electrical interests, securing therefrom a broad and valuable experience, which is a necessary factor to the advancement of telephone work, and with the apparatus which this company are now handling and the vast opportunities for work in the telephone field, a successful future seems assured.

Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE Electrical Engineer.

Vol. XVIII.

SEPTEMBER 5, 1894.

No. 331.

PUBLIC LIGHTING BY MUNICIPAL PLANTS.

BY

Horatio A. Foster

EARLY this year the following letter was sent out by THE ELECTRICAL ENGINEER to the officials of some 150 municipalities in this country owning electric lighting plants.

NEW YORK, 203 Broadway, Jan. 15, 1894.

Dear Sir: The subject of municipal lighting plants assumes more importance every year, and there is a corresponding desire

We need hardly say that we count on your hearty help and coöperation in this matter. Aside from the information that will be secured, bearing upon one of the most noteworthy movements of our times, we may point out that you will derive direct personal benefit from the work we are attempting, as the results will be freely placed at your disposal. If your city plant is running at a greater comparative expense than others, you need to know the fact so as to bring it up to a state of higher efficiency. If it is operating better than others and at a less expense, you may fairly take pride in pointing to the fact. Even then, you may discover that the cost of some one branch is not in keeping with the cost of the same at another station.

The success of all municipal lighting plants depends upon their showing, and upon the application to them of sound principles of operation and accounting. Such an inquiry as we have set on foot tends entirely in that direction, and for that reason invites your support.

In filling up the schedule, the last fiscal year should be used.

STATE OF _____
CITY or TOWN OF _____
Name and address of City Official in charge of plant _____
End of fiscal year, date of this report _____
Total cost of plant to date. \$ _____
Paid for, by appropriation, amount. \$ _____
Paid for, by bonds, amount issued. \$ _____
Rate of interest on bonds _____ per cent.
Taxation, total, for past year _____
State, County, City, School and General.
EQUIPMENT,
Motive power, total rated horse power _____
Dynamos, Arc, total lights capacity _____ Amperage _____
" Incandescent, total capacity in 16 c. p. lamps _____
Distributing system, miles overhead lines _____
" " underground lines _____
INSTALLATIONS,
Arc lamps, street, number connected _____
" Commercial, number connected _____
Incandescent lamps, street, number connected _____
" " Commercial, number connected _____
Power, number motors connected _____ total rated h. p. _____

REMARKS:

OPERATING EXPENSE. Labor..... \$ _____
Fuel..... \$ _____
Supplies and general expense... \$ _____
Office and official expense..... \$ _____
Total..... \$ _____
FIXED CHARGES FOR THE YEAR.
Amount of interest paid and accrued, \$ _____
Amount charged off for depreciation, \$ _____
Amount paid to Sinking Fund..... \$ _____
Total..... \$ _____
Total cost for the year..... \$ _____
INCOME FOR THE YEAR.
From commercial business..... \$ _____
From miscellaneous sources..... \$ _____
Total..... \$ _____
Balance, net cost to city for operation \$ _____
STREET LIGHTING.
Schedule used _____
Number of nights lighted during the year _____
Number of hours lighted during the year _____
Average number of nights per month lighted _____
Other lighting, (such as public buildings), number, style and size of lamps _____
Average number hours per year each _____
COMMERCIAL PRICES, Arc _____
Incandescent _____
Power _____

FORM OF BLANK USED IN "THE ELECTRICAL ENGINEER" MUNICIPAL PLANT INVESTIGATION.

on the part of the public for information as to the success and economy of the plants already in operation. Up to the present time, very little exact or detailed data has been obtained, so that the arguments in favor of municipal control rest, even now, largely on the saving assumed rather than proved.

With the object of eliciting and publishing the facts in regard to city plants, THE ELECTRICAL ENGINEER is now engaged in making an entirely impartial canvas of the subject, and with the intention of putting the facts and figures in the best and simplest form, it has prepared the accompanying schedule, which can be filled up by the proper officer with very little trouble. The reports when received will be submitted to a well known expert engineer and accountant, and the general conclusions will be published.

If you will also send us a copy of the report of your city auditor or city clerk, or official charged with the duty of presenting the city's financial statement, it may be of assistance to us in checking or expanding our figures.

Asking you to be as prompt as possible in your kind response to our invitation, believe me,

Yours very truly,

T. C. MARTIN, Editor.

Enclosed with the above letter was a blank form to be filled out by the official in charge of public lighting: (See reduced copy above.) This form was made up by the writer and only calls for the simplest kind of statement;

in fact it is so simple in some ways as to be partially open to question of its value. In the light of past experience this was done for the purpose of getting as many returns as possible by limiting the number of inquiries, and it was also thought the reports would be more carefully filled out for the same reason.

tables, but, only those considered fairly accurate have been fully extended. In some instances where the returns are not furnished in full detail, the writer has been able to estimate the items from the data given and these estimates have been tabulated with the rest, all estimated items appearing in display type.

TABLE I.

No.	State.	City or Town.	By whom reported.	End of Fiscal Year.	CAPITAL INVESTMENT.					EQUIPMENT.				
					Par value of bonds issued.	Rate of Int.	Amount of appropriation.	Total cost of plant.	Cost per K. W. capacity.	H. P. steam.	H. P. water.	Lamp Capacity in Dynamos.		
												Arc.	Amp. cap.	Miles wire.
1	Ind.	Goshen.....	C. S. Dill, Supt.....	Dec. 31, '93..			\$11,000.00	\$11,000.00	\$572.92	50		40	10.0	8.5
2	Minn.	Fulda.....	.....	Not a whole year yet.	\$1,000	6	4,000.00	5,000.00	166.66	50				500 3.0
3	Ill.	Peru.....	.....	.....										
4	Minn.	Rochester.....	.....	Now being erected.										
5	Wisc.	Hudson.....	D. C. Fulton, Mayor...	Nov. '93.....			7,000.00	7,000.00	429.44	rented		50	6.8	
6	Neb.	Crete.....	S. H. Swayne, Elec.....	.....			9,500.00	9,500.00	582.82			50	6.8	
7	Me.	Lewiston.....	P. J. Joyce.....	.....			15,000.00	16,000.00	333.33		200	100	9.6	14.0
8	Penna.	Easton.....	R. H. Lerch, Supt.	March 31, '93	34,000	4	5,944.94	39,994.94	617.20	100		135	10.0	20.0
9	Cal.	Santa Cruz.....	W. W. Waters, Supt....	.....						92		80	6.4	16.0
10	Wash.	Chehalis.....	Fred. W. Low, Supt....	Dec. 31, '93..	valued at 8,000 12,000	8	7,000.00	15,000.00	252.52	120		30	10.0	750 8.0
11	Tex.	Galveston.....	Committee on Lighting	March 1, '93..			Per year for 5 years, 8,000.00	40,000.00	326.80	300		210	18.0	360 54.0
12	Minn.	Luverne.....	W. F. Kendall.....	Jan. 25, '94..	6,050	7	2,800.00	9,800.00	123.74	125		40	9.5	1 000 3.5
13	Ore.	Portland.....	Sold out to G. E. Co....	.....						100				
14	Iowa	Harlan.....	J. A. Hinkle.....	.....										960
15	N. Y.	Dunkirk.....	John Maddigan, Clerk.	Dec. 31, '93..			19,866.98	19,866.98	394.18	100		105	18.0	
16	Conn.	So. Norwalk.....	A. E. Winchester, Com.	Oct. 12, '93..			21,600.00	21,600.00	486.50	100		120	8.0	15.0
17	Mo.	Shelbina.....	J. S. Preston, Mayor..	Jan. 1, '94....	5,000	7	2,122.37	7,122.37	182.62	60				650 5.0
18	N. J.	Madison.....	F. E. Day, Manager....	.....	35,000			35,000.00	176.77	330				3,300 55.0
19	Md.	Frederick.....	J. F. Eisenhauer.....	Oct. 1, '93....			15,000.00	15,000.00	520.83	100		60	9.6	8.0
20	Va.	Farmville.....	John R. Martin.....	Dec. 31, '93..	10,000	6	2,000.00	12,000.00	370.87	80		30	10.0	300
21	Ill.	Metropolis.....	Thos. L. Davis, Supt..	.....		7				100		60	9.5	660 11.0
22	Mo.	Rock Port.....	W. R. Littell.....	Jan. 22, '94..	12,000	6	2,000.00	14,000.00	466.66	65				500 3.0
23	Iowa	Fairfield.....	T. F. Heyley.....	March 1, '93..			6,000.00	6,000.00	416.66	25		30	10.0	4.0
24	Kans.	Council Grove.....	Preston Little.....	.....	7,000	6	1,000.00	8,000.00	490.80	45		50	6.8	5.0
25	Ark.	Hope.....	John T. Barr & others	.....			4,800.00	4,800.00	228.60					350 1.0
26	Iowa	Tipton.....	.....	Burned.....										
27	Minn.	Arlington.....	V. F. Schmoll.....	Jan. 30, '94..			3,000.00	3,000.00	291.26	40		4	6.8	150
28	.....	.....	J. F. Saunders.....	Out a year.....										
29	Ind.	Anderson.....	R. H. Cokefield, Supt..	.....			27,550.00	27,550.00	318.63	250		180	9.5	31.7
30	Neb.	Falls City.....	A. Minnick.....	Jan. 23, '94..	7,000	5	2,000.00	9,000.00	250.00	60				600 18.0
31	Ind.	Crawfordsville.....	Fred. H. Brown, Supt..	May 18, '94..										
32	Ga.	Madison.....	T. B. Baldwin, Man....	April 1, '94..	6,400	6		23,000.00	365.08	125		50	9.6	650 5.0
33	Ohio	St. Clairsville.....	C. S. Frint, Supt.....	Jan. 1, '94....	10,000	5		10,000.00	225.22	80		30	10.0	500
34	Mo.	Hannibal.....	W. R. Spencer, Supt....	June 1.....	40,000	2		46,931.00	211.40	300		150	10.0	2,500
35	Ill.	Aurora.....	J. Kennedy, City Clerk	Jan. 1, '94....			45,323.53	45,323.53	377.69	200		250	10.0	61.5
36	Ark.	Little Rock.....	G. E. Fish, Supt.....	June 1, '93....			39,739.37	39,739.37	570.97	150		145	20.0	27.0
37	Kans.	Lyons.....	E. A. Maxwell.....	Jan. 23, '93..			5,500.00	5,500.00	169.75			30	18.0	308
38	N. C.	High Point.....	F. A. Dickins.....	.....						35		75	6.8	9.0
39	Iowa	Marshalltown.....	J. G. Trotter, City Clk.	March 13, '94.			12,000.00	12,000.00					10.0	16.0
40	Tenn.	Harriman.....	.....	On trial only.										
41	Cal.	Alameda.....	W. M. Goldthwaite....	June 30, '93..	25,000	5	15,000.00	*45,000.00	986.84	100		95	17.0	20.0
42	Ohio	Painesville.....	H. P. Sanford, Clerk..	Jan. 1, '94....	13,000	5		13,000.00	300.92	101		90	18.0	17.0
43	Minn.	Sleepy-Eye Lake.....	T. H. Pagenhoff, Eng..	'93.....						40		60	6.8	
44	Penna.	Quakertown.....	Gottlieb Frey, Supt....	13 months, Dec. 31, '93..	15,000	4	3,437.00	18,437.00	328.06	120		50	7.0	665 6.5
45	Ill.	Chicago.....	J. P. Barrett.....	Dec. 31, '93..			688,312.80	688,312.80	774.13	1,925		1,850	10.0	u.g. 193
46	Ill.	Elgin.....	H. E. Shedd, City Elec.	Dec. 31, '93..		5		24,000.00	400.00	100		125	18	27.0
47	N. Y.	West Troy.....	C. Robinson, Secy.....	.....				26,000.00	525.88	125		103	10.0	10.0
48	N. Y.	Westfield.....	J. G. Finley, Supt....	March 7, '94..	12,000	4	1,000.00	13,000.00	169.27	100		60		800 13.0
49	Mich.	Bay City.....	.....	Feb. 28, '94..			35,983.17	35,983.17	413.60	200		180	8½	

* As per report.

NOTE.—Roman type according to report received; display type are estimates.

In answer to this request 49 returns were received. Out of the total number of returns, 7 made no answer whatever to the questions for reasons stated in the remarks; of the remaining 42 reports, 34 have given data sufficient to allow of tabulation in full. The returns are all numbered, and the tabulation done without reference to alphabetical order. Each report is accounted for in the

The object of this report is so well stated in Mr. Martin's letter that no repetition is needed here.

There can be no doubt now that lighting by municipalities has come to stay—for a time at least—and, as the growth in number seems to have been large in the past three years (particularly in Ohio, Indiana, Illinois and Iowa, the number of plants in these four States being

49), it is thought that a careful tabulation and study of the data from such work will give some aid in determining the reasons for such growth, and possibly the actual unit cost of the supply of light to the municipalities.

As far as possible all expression of opinion has been omitted, for fear it might be taken as favoring one side or

admitted that in quite a number of cases such has been the fact.

A large proportion of the reports received appear to be quite correctly rendered, but in a general way it may in all fairness be said that municipal bookkeeping seems to be in a bad way. In but two instances has there

TABLE I.

EQUIPMENT.				Total capacity of dynamos. Kilowatts.	OPERATING EXPENSES.					FIXED CHARGES.			Total Cost.	No.
Street Lamps.		Com- mercial.			Labor.	Fuel.	Supplies.	Office.	Total.	Interest.	Depc. 7½%	Total.		
Arcs.	Inc.	Arcs.	Inc.											
40				19.20	\$1,277.50	\$1,188.00	\$250.00		\$2,715.50	\$660.00	\$825.00	\$1,485.00	\$4,200.50	1
	30		200	30.00	540.00	600.00	120.00		1,260.00	240.00	375.00	675.00	1,935.00	2
										60.00				3
														4
50				16.30	450.00	450.00	600.00		1,500.00	420.00	525.00	945.00	2,445.00	5
21		12		16.30	1,260.00	960.00	350.00		2,570.00	570.00	712.50	1,282.50	3,852.50	6
100				48.00	2,200.00	1,100.00	1,700.00		5,000.00	960.00	1,200.00	2,160.00	7,160.00	7
108				64.80	2,454.63	3,043.25	2,806.98	600.00	8,906.96	1,360.00	2,999.55	4,599.34	13,506.30	8
75				26.08	235.00	140.00				239.79				9
26	24 8		500	59.40	2,160.00	3,000.00	480.00		5,640.00	960.00	1,125.00	2,645.00	8,285.00	10
										560.00				
191	360			122.40	7,306.64	3,653.32	5,646.37		16,606.33	2,400.00	3,000.00	5,400.00	22,006.33	11
12		18	h. p. mot'r 750	79.20	810.00	1,715.50	400.00		2,925.50	196.00	735.00	1,354.50	4,280.00	12
										4,285.50				13
				57.60										14
3 71		1		50.40	952.91	1,243.73	1,307.80		3,504.44	993.35	1,490.02	2,483.37	5,987.81	15
90	3			44.40	2,395.00	1,500.00	525.43		4,420.43	1,012.50	375.00	1,387.50	5,807.93	16
	47		300	39.00	720.00	976.00	869.16	65.00	2,630.16	148.56	534.12	1,032.68	3,662.84	17
	30 c.p. 400		1,826	198.00						350.00				18
65				28.80	1,540.00	770.00	1,190.00		3,500.00	900.00	1,125.00	2,025.00	5,525.00	19
25			360	32.40	1,380.00	1,100.00	200.00		2,580.00	120.00	900.00	1,620.00	4,200.00	20
										600.00				
34			660	68.40	1,920.00	1,080.00	300.00		3,300.00					21
	65		370	30.00	1,000.00	900.00	350.00	380.00	2,610.00	120.00	930.00	1,890.00	4,500.00	22
14				14.40	420.00	400.00	165.56		985.56	360.00	450.00	810.00	1,795.56	23
10		10	45	16.30						420.00	600.00	1,020.00	2,420.00	24
	52		150	21.00	480.00	200.00			680.00	288.00	360.00	648.00	1,325.00	25
4	20		100	10.30	850.00	425.00	200.00		1,475.00	180.00	225.00	405.00	1,880.00	26
														27
150				86.40	3,420.00	219.00	1,542.00		5,181.00	1,653.00	2,066.25	3,719.25	8,900.25	28
	150		630	36.00	1,200.00	980.00	150.00	350.00	2,680.00	100.00	675.00	1,125.00	3,805.00	29
										350.00				30
														31
39	4 9		262	63.00	1,680.00	1,566.00	2,500.00	100.00	5,846.00	996.00	1,725.00	3,105.00	8,951.00	32
										384.00				
30			400	44.00	500.00	300.00	450.00	75.00	1,725.00	500.00	750.00	1,250.00	2,975.00	33
75		25	2,000	222.00	3,036.44	1,518.22	2,347.02		6,901.68	415.86	3,519.87	5,122.73	12,024.41	34
										1,187.00				
179	7			120.00	5,373.33	3,164.28	949.67	593.93	10,081.21	2,719.41	3,399.22	6,118.63	16,199.81	35
132				69.60	4,637.10	2,439.11	1,974.37		9,050.78	2,384.36	2,980.42	5,364.78	14,415.56	36
20		8	303	32.40	300.00	396.00	30.60		726.60	330.00	412.50	742.50	1,469.10	37
32		1	100	24.45	600.00	556.00	150.00		1,306.00					38
64					528.00	264.00	408.00		1,200.00	720.00	900.00	1,620.00	2,820.00	39
														40
95				45.60	4,200.00	3,200.00	4,000.00		11,400.00	750.00	3,375.00	5,375.00	16,775.00	41
										1,250.00				
70				43.20	1,680.00	857.97	930.32		3,468.29	200.00	975.00	1,625.00	5,093.29	42
										450.00				
15		45		19.56	926.20	463.10	715.85		2,105.15					43
37	32		600	56.20	1,719.00	1,200.00	2,545.93		5,464.93	206.22	1,382.77	2,188.99	7,653.92	44
										600.00				
1,110				888.00	57,528.92	28,509.87	21,239.14		107,277.93	36,000.00	45,000.00	81,000.00	188,277.93	45
98				60.00	3,200.66	1,800.00	1,814.66		6,815.32	1,200.00	1,800.00	3,000.00	9,815.32	46
103				49.44	2,496.00	2,700.00	1,000.00	100.00	6,296.00	1,560.00	1,950.00	3,510.00	9,806.00	47
60			400	76.80	2,012.93	635.07	3,305.47		5,953.47	60.00	975.00	1,495.00	7,448.47	48
181				87.00	3,110.25	2,139.07	2,465.07	1,264.45	8,978.84	1,794.65	2,691.98	4,486.63	13,465.47	49

* As per report.

NOTE.—Roman type according to report received; display type are estimates.

the other; and to get at the exact facts is the only desire of the writer. Some very adverse comments from city officials are appended; others commending the work would have been printed, but there were none of special moment. The tone of all communications from those favoring the municipal side seems to have taken it for granted that the results shown would tell that side sufficiently well, and it must be

been any allowance made for depreciation, and in but 17 instances has interest on bonds or cost of plant been computed. Most of the figures on these two items have been calculated by the writer and entered in the report in display type. These figures have not in every instance been made at the same percentage, but in some cases on the basis of the stated rate of interest on bonds.

Depreciation has in most instances been computed at $7\frac{1}{2}$ per cent. of the entire cost of the plant. This figure in the writer's opinion and experience is as nearly correct as any. In this connection it is but fair to say that in a comparison of municipal with private plants, the charging off for depreciation and interest is fully as much neglected by one as by the other; less than one in ten of either paying any attention whatever to these items. In but few cases has any allowance been made—or shown—for the expense of accounting or other office expenditure.

As in most municipal plants the bookkeeping is limited to looking after supply accounts, this item will naturally be small and will cut very little figure in most of the expense accounts. To the writer's knowledge, in many small towns the municipal accounting is all done by some one of the town officials who receives little if any pay for it and it can be admitted without particular bias that the bookkeeping is in such instances fully up to its cost. In some cases in this report it is probable that cost of clerk hire has been included in the cost of labor, and other office expense included in the cost of supplies. Some municipalities have reported such large incomes in proportion to the operating expense that unless there are circumstances plainly indicating the reasons for such a disproportion, the unit costs have not been extended.

Referring now to the tables :

Table No. I gives the name of the State, Town, city official who made the report, date of the end of the fiscal year, capital investment, equipment, and ends with the operating expenses and fixed charges.

In several instances where the total amount of operating expense is stated in the return, but not given in detail, the separate amounts have been computed from the total stated at the following rates; for labor 44 per cent. of the total operating expense; for fuel 22 per cent. of the same amount; and 34 per cent., or the remainder, for supplies, etc. So few reports include any item of office expense and it being a small item anyway, in making necessary division, this item has been ignored entirely.

Table No. II deals with the lamps connected, and the output in kilowatts from the same. The first section includes lamps used for public street lighting, under the heads of arcs and incandescents; giving the number, hours per year each lamp is in use, total lamp hours, *estimated* watts per lamp and total kilowatts out-put for each style. Under the second section, commercial lamps are tabulated in a similar manner and the last column gives the total output for the year for the plant.

Referring to the watts per lamp under city arc lamps, the writer has with few exceptions taken 480 watts and 326 watts for the value of full arc and divided arc lamps, respectively.

The variation in pressure across the terminals of arc lamps is in most cases considerable, and in the writer's experience 48 volts is a fair average for both lamps where the current is 10 amperes and 6.8 amperes, respectively; as with few exceptions these are the standards shown in these returns the rating will be considered the average, as nearly correct as possible, and it brings all lamps to the same basis. For incandescent lamps the unit per lamp is taken at 60 watts; as few reports state the candle-power, perhaps but little value may be given to the exactness of the output under this head, although in the writer's opinion the extreme error will not reach 5 per cent. The cost per *lamp-hour* for city lamps will in any case be correct as the output is multiplied by, and the cost per kilowatt is divided by the same unit.

The time of burning for commercial lamps had to be estimated for each class, wholly from experience as no statement from the record could be used and meters for measuring the output are rare in municipal plants. The writer places little value on the results shown under this head excepting where the commercial output is but a small proportion of the total.

Out of 42 returns giving any data at all, 22 are doing commercial lighting. Out of the number reporting commercial work 14 give a greater output for commercial than for public lighting.

Right here there is one point to which the writer wishes to call especial attention; viz.: Of the 34 reports in which the unit costs have been extended, 13 towns have less than 3,000 inhabitants according to the census of 1890; 5 towns have between 3,000 and 5,000; 4 towns between 5,000 and 10,000; 7 cities between 10,000 and 20,000; 4 cities between 20,000 and 30,000; and one only is of the first class, or over 1,000,000. From this it will be seen that somewhat over half the number are places where it is very doubtful if a commercial or private plant could be made to pay under any circumstances!

Table No. III groups the totals from the two preceding tables, showing the total output in kilowatts for public and commercial lamps, and the sum of both; then the cost of operating the same or rather the total cost of this output, divided into operating expense and fixed charges. From this amount is deducted any income received from commercial lighting, leaving the net cost to the municipality of operating the public lamps in the last column. In the "Remarks" column are given any explanatory notes accompanying the reports, and most of them are devoted to stating the price of commercial lighting.

Table No. IV is devoted to final results, grouping the unit costs under various heads, and stating them in two units, i. e., kilowatt-hour and lamp-hour, in order that the reader may make use of the one with which he is most familiar. Under the heading of operating expenses the total cost of each item is divided by the whole output in kilowatts and the cost per lamp-hour is then computed by dividing the result by the number of watts per lamp for each particular station. Arc-lamp hour is used as the unit for all stations excepting Nos. 2, 17, 22, 25 and 30; in those, incandescent lamp-hour is the second unit. The unit cost for fixed charges is determined in the same manner and the total unit cost is the sum of the two, operating expenses and fixed charges. This final result is checked by dividing the total output into the total cost.

The net cost for public lighting is found by dividing the total output for city lighting into the net cost for the same after deducting the income from commercial work from the total expenditure.

The population of each town by the census of 1890 is given, and in the last columns are the names of municipalities in New York State which may be compared with those in this report as being of similar size and style of lighting. The data on New York State are taken from the *U. S. Census Report on Electrical Industries*. For purposes of comparison the reports have been classified as follows, the numbers, following each head, being those designating the stations in the margins of the tables.

Full arc lamps, for city use only : Station Nos. 1, 7, 8, 19, 23, 29, 36, 39, 41, 42, 45, 46, 47 and 49. Total, 14.

Divided arc, for city use only : Station No. 5.

Incandescent lamps, city and commercial use : Station Nos. 2, 17, 22, 25 and 30. Total, 5.

Full arc lamps, city and commercial use : Station No. 15.

Divided arc lamps, city and commercial use : Station No. 6.

Full arc and incandescent lamps, for city use only : Station Nos. 11 and 35.

Arc lamps of 370 watts, and incandescent lamps, for city use only : Station No. 16.

Full arc lamps, and incandescent lamps, for city and commercial use : Station Nos. 10 and 32.

Divided arc lamps, and incandescent lamps for city and commercial use : Station Nos. 27 and 44.

Full arc lamps for city use, and full arc and incandescent lamps for commercial use : Station Nos. 12, 20, 33, 34 and 48. Total, 5.

Table No. V has been prepared to show the average

costs per k. w. and per lamp hour for lamps under the above headings: The 1st, 3d and 7th items on this table may be relied on as being as nearly correct as it is possible to get statistics by correspondence. The rest may be considered substantially correct.

In discussing the question of cost in lighting by municipal plants the items usually in dispute are interest, depreciation, insurance and taxes. As it is merely a question of book-keeping where and how these items shall be charged and as the two last items together seldom amount to 6 per cent.

TABLE II.

LAMPS CONNECTED.

CITY STREET LAMPS.										COMMERCIAL.									
No. of City.	Arca.					Incandescents.					Total kilowatts for city lamps.	Incandescents.					Total kilowatts for commercial lamps.	No. of City.	
	No.	Hours per lamp.	Total lamp hours.	Watts per lamp.	Kilowatts total.	No.	Hours per lamp.	Total lamp hours.	Watts per lamp.	Kilowatts total.		No.	Hours per lamp.	Total lamp hours.	Watts per lamp.	Kilowatts total.			
1	40	2,168	86,720	480	41,025.6	30	2,190	65,700	60	3,942	41,025.6	300	72,000	14,400	14,400	41,025.6	1		
2	3	...	...	...	...	...	...	...	...	...	3,942	...	...	...	...	18,343	2		
3	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3		
4	50	2,208	110,400	336	36,960.4	...	...	...	...	...	36,960.4	...	...	...	...	36,960.4	4		
5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5		
6	21	1,580	33,390	336	10,885.1	...	...	...	...	...	10,885.1	13	391,200	4,944	4,944	15,579.5	6		
7	100	2,786	278,500	480	133,680	...	...	...	...	...	133,680	...	...	...	...	133,680	7		
8	108	3,021	327,348	480	157,127	...	...	...	...	...	157,127	...	...	...	...	157,127	8		
9	75	2,208	165,600	336	53,985.6	24	2,000	4,800	4,800	...	53,985.6	...	...	...	...	53,985.6	9		
10	26	3,950	102,700	480	49,296	8	3,950	31,600	60	2,184	51,480	500	72,000	36,000	36,000	87,480	10		
11	191	2,700	515,700	480	247,536	380	3,300	1,404,000	60	84,340	331,776	...	...	...	...	331,776	11		
12	12	1,815	21,780	480	10,454	...	...	...	...	...	10,454	18	576,000	10,368	10,368	81,122	12		
13	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	13		
14	8	2,915	23,320	480	10,406.4	...	...	...	...	...	10,406.4	1	576,000	576	576	105,182.4	14		
15	71	2,945	217,980	480	104,606.4	...	...	...	...	...	104,606.4	...	...	...	...	104,606.4	15		
16	90	2,255	202,950	370	75,090.5	3	2,000	6,000	60	360	75,430.5	...	...	...	...	75,430.5	16		
17	17	...	...	...	...	47	2,160	101,520	60	6,091.2	6,091.2	...	...	...	...	27,691.2	17		
18	18	...	...	...	...	400	2,160	864,000	130	103,680	103,680	...	...	...	...	213,240	18		
19	65	2,160	140,400	480	67,332	...	...	...	...	...	67,332	...	...	...	...	67,332	19		
20	25	2,160	54,000	480	25,920	...	...	...	...	...	25,920	...	...	...	...	25,920	20		
21	34	1,452	49,368	480	23,906.6	...	...	...	...	...	23,906.6	...	...	...	...	23,906.6	21		
22	22	...	...	...	...	65	2,500	162,500	130	19,500	19,500	...	...	...	...	47,520	22		
23	14	1,680	23,520	480	11,380.6	...	...	...	...	...	11,380.6	...	...	...	...	26,540	23		
24	10	2,000	20,000	336	6,300	...	...	...	...	...	6,300	10	391,200	3,912	3,912	11,280.6	24		
25	...	...	...	...	...	52	2,160	112,320	60	6,739.2	6,739.2	...	...	...	...	17,539.2	25		
26	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	26	
27	4	2,000	8,000	336	2,608	20	2,000	40,000	60	2,400	5,008	...	...	...	...	7,200	27		
28	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	28	
29	150	3,360	591,000	480	284,400	...	...	...	...	...	284,400	...	...	...	...	284,400	29		
30	...	...	...	...	...	150	2,500	375,000	60	23,500	23,500	...	...	...	...	45,360	30		
31	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	31	
32	39	2,160	84,240	480	40,435.2	4	2,160	8,640	60	518.4	42,120	...	...	...	...	18,864	32		
33	30	2,232	66,480	480	32,808.0	9	2,160	19,440	60	1,166.4	32,808.0	...	...	...	...	28,800	33		
34	75	2,190	164,250	480	79,940	...	...	...	...	...	79,940	...	...	...	...	134,400	34		
35	179	2,436	434,364	480	208,441.9	7	2,000	14,000	60	840	209,281.9	...	...	...	...	309,281.9	35		
36	132	2,168	286,176	480	137,844.5	...	...	...	...	...	137,844.5	...	...	...	...	137,844.5	36		
37	20	2,000	40,000	480	19,200	...	...	...	...	...	19,200	...	...	...	...	26,734	37		
38	32	2,160	69,120	336	22,536.1	...	...	...	...	...	22,536.1	1	391,200	391.2	391.2	80,124.8	38		
39	64	1,950	124,800	480	59,904	...	...	...	...	...	59,904	...	...	...	...	59,904	39		
40	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	40	
41	95	1,480	134,900	480	64,792	...	...	...	...	...	64,792	...	...	...	...	64,792	41		
42	70	1,888	132,660	480	61,768.8	...	...	...	...	...	61,768.8	...	...	...	...	61,768.8	42		
43	15	1,800	27,000	336	8,602	...	...	...	...	...	8,602	45	391,200	17,604	17,604	96,406	43		
44	37	2,183	81,141	336	26,452	32	156	4,992	60	399.5	26,751.5	...	...	...	...	43,300	44		
45	1,110	3,360	4,838,102	480	2,108,889	...	...	...	...	...	2,108,889	...	...	...	...	2,108,889	45		
46	98	2,500	245,000	480	117,600	...	...	...	...	...	117,600	...	...	...	...	117,600	46		
47	108	3,960	426,880	480	185,288	...	...	...	...	...	185,288	...	...	...	...	185,288	47		
48	60	1,700	102,000	480	48,960	...	...	...	...	...	48,960	...	...	...	...	77,780	48		
49	180	2,418	435,268	480	210,076	...	...	...	...	...	210,076	...	...	...	...	210,076	49		

NOTE.—Roman type, according to report received; display type are estimates.

TABLE III.

No.	State.	City or Town.	OUTPUT.—KILOWATTS.			EXPENSES.			Income.	Net Cost to City.	REMARKS.
			Public Lighting.	Commer- cial Cur- rent.	Total watts.	Operat- ing.	Fixed, Interest and De- preciation.	Total.			
1	Ind.	Goshen.....	41,626		41,626	\$2,715.50	\$1,485.00	\$4,200.50		\$4,200.50	1 Burn crude oil. Moonlight schedule. Run with water works. Former cost \$156.
2	Minn.	Fulda.....	3,942	14,400	18,342	1,260.00	675.00	1,935.00	\$840.00	1,095.00	2 Price for commercial incandescents, 50 and 25 cents.
3	Ill.	Peru.....									3 Letter from T. Weberling says plant is run in connection with water works and cannot give separate expenses.
4	Minn.	Rochester.....									4 This plant in process of construction.
5	Wis.	Hudson.....	35,990		75,990	1,500.00	945.00	2,445.00		2,445.00	5
6	Neb.	Crete.....	10,885	4,694	15,579	2,570.00	1,282.50	3,852.50	1,008.00	2,844.50	6 Commercial arc lamps, running to 10.30 p. m. \$7.00 per month.
7	Me.	Lewiston.....	133,690		133,690	5,000.00	2,160.00	7,160.00		7,160.00	7 Motive power is water.
8	Penna.	Easton.....	157,127		157,127	8,906.96	4,599.34	13,506.30		13,506.30	8
9	Cal.	Santa Cruz.....	53,986		53,986	5,640.00	2,645.00	8,285.00	3,600.00	4,685.00	9
10	Wash.	Chehalis.....	51,480	36,000	87,480	16,606.33	5,400.00	22,006.33		22,006.33	10
11	Tex.	Galveston.....	331,776		331,776	2,925.50	1,354.50	4,280.00	4,950.00	20.00	11 Commercial arcs \$6.00 and \$7.00; incs. 16 c. p., 50 cts.; 32 c. p., 90, per month. Meter rate 10 cts. per 1,000 watt-hours.
12	Minn.	Luverne.....	10,454	70,668	81,122						12
13	Ore.	Portland.....									13
14	Iowa.	Harlan.....									14
15	N. Y.	Dunkirk.....	104,606	576	105,182	3,504.44	2,463.37	5,967.81	72.00	5,915.81	15
16	Conn.	So. Norwalk.....	75,451		75,451	4,430.43	1,387.50	5,807.93		5,807.93	16
17	Mo.	Shelburne.....	6,091	21,600	27,691	2,630.16	1,032.68	3,662.84	2,584.15	1,078.69	17 Commercial lamps average 5 1/2 cents per month.
18	N. J.	Madison.....	103,680	109,560	213,240						18 Commercial lamps 15 cents per 1,000 watts.
19	Md.	Frederick.....	67,392		67,392	3,500.00	2,025.00	5,525.00		5,525.00	19
20	Va.	Farmville.....	35,920	21,000	47,520	3,500.00	1,620.00	4,200.00	3,328.00	672.00	20 Commercial arcs \$6.75 per month; incandescents 50 cents per month.
21	Ill.	Metropolis.....	23,697	47,520	71,217	3,800.00			1,740.00		21 Run in connection with water works.
22	Mo.	Rockport.....	19,500	26,640	46,140	2,610.00	1,890.00	4,500.00	4,210.00	290.00	22
23	Iowa.	Fairfield.....	11,390		11,390	985.56	810.00	1,795.56		1,795.56	23
24	Kans.	Council Grove.....	6,320	13,632	20,152		1,830.00		2,100.00		24 Commercial arcs \$6.25 per month; 32 c. p. incandescents, \$1.50; 65 c. p., \$3.50 per month.
25	Ark.	Hope.....	6,739	10,800	17,539	680.00	648.00	1,328.00	770.00	558.00	25
26	Iowa.	Tipton.....									26
27	Minn.	Arlington.....	5,008	7,320	12,328	1,475.00	405.00	1,880.00	800.00	1,080.00	27 Commercial incandescents 75 cents per month. Motive power rented.
28	Ind.	Anderson.....	284,400		284,400	5,181.00	3,719.25	8,900.25		8,900.25	28
29	Ind.	Falls City.....	23,500	45,300	67,800	2,080.00	1,125.00	3,805.00	3,780.00	25.00	29 Commercial incandescents 50 cents per month.
30	Neb.										30
31	Ind.	Crawfordsville.....									31
32	Ga.	Madison.....	42,120	18,864	60,984	5,496.00	3,105.00	8,601.00	1,550.90	7,400.10	32 Commercial incandescents per month, \$1.00, 85, 75, 65, 50, 30 cents.
33	Ohio.	St. Clairsville.....	82,861	28,800	111,661	1,725.00	1,250.00	2,975.00	950.00	2,025.00	33 Commercial incandescents, 30 cents for 16 c. p., 45 cents for 25 c. p.
34	Mo.	Hannibal.....	78,840	134,400	213,240	6,901.68	5,122.73	12,024.41	6,231.94	5,792.47	34 Commercial arcs, \$9.00 to 10 p. m.; \$10.00 to 12 p. m.; \$12 all n't. Incs. 50 to 12 p. m.; 75 all n't. 10c. per 1,000 watt-hours.
35	Ill.	Aurora.....	209,282		209,282	10,081.21	6,118.63	16,199.84		16,199.84	35
36	Ark.	Little Rock.....	137,365		137,365	9,050.78	5,364.78	14,415.56		14,415.56	36
37	Kans.	Lyons.....	19,200	26,784	45,984	726.00	742.50	1,468.50	4,524.00		37 Commercial arcs \$9.00; incandescents, \$1.00 to 60 cents all per month.
38	N. C.	High Point.....	22,533	7,591	30,124	1,300.00	1,620.00	2,920.00	720.00		38 Commercial arcs \$4.50; incandescents 50 for 25 c. p., 75 for 50 c. p.
39	Iowa.	Marshalltown.....	59,904		59,904	1,200.00	1,620.00	2,820.00		2,820.00	39
40	Tenn.	Harriman.....									40
41	Cal.	Alameda.....	64,752		64,752	11,400.00	5,375.00	16,775.00		16,775.00	41 Commercial prices not plain.
42	Ohio.	Painesville.....	61,757		61,757	3,403.24	1,025.00	5,008.24		5,008.24	42 Meter rates 12 cents per 1,000, 38 1/2 per cent. off in 10 days; arcs \$5.25 per month all night.
43	Minn.	Sleepy-Eye Lake.....	8,902	17,604	26,506	2,105.15	2,188.00	4,293.15	2,407.90		43
44	Penna.	Quakertown.....	26,782	48,200	74,982	5,464.93	2,188.00	7,652.93	2,640.28	5,012.64	44
45	Ill.	Chicago.....	2,103,889		2,103,889	107,277.93	81,000.00	188,277.93		188,277.93	45
46	Ill.	Elgin.....	117,600		117,600	6,815.32	3,000.00	9,815.32		9,815.32	46
47	N. Y.	West Troy.....	195,288		195,288	3,510.00	3,510.00	7,020.00		7,020.00	47
48	N. Y.	Westfield.....	48,960	28,900	77,860	5,933.47	1,405.00	7,448.47	1,110.56	6,337.91	48 Commercial incandescents 40 cents per 16 c. p., 70 cents for 32 c. p. Meter rate 1/4 cent per amp. hour.
49	Mich.	Bay City.....	210,076		210,076	8,978.63	4,486.63	13,465.26		13,465.26	49 Burn slabs.

NOTE.—Roman type according to report received; display type are estimates.

TABLE IV.

UNIT COSTS IN DOLLARS.																				
No.	OPERATING EXPENSE.										TOTALS.				Name of City in N. Y. state census.	No.				
	Labor.		Fuel.		Supplies.		Office.		Operating expenses for total out-put. d+c+e	Fixed charges for total out-put. e+f+g		Total cost. f+g+h		Net cost for public lighting. h+a+b						
	Per kilo-watt.	Per lamp-hour.	Per kilo-watt.	Per lamp-hour.	Per kilo-watt.	Per lamp-hour.	Per kilo-watt.	Per lamp-hour.		Per kilo-watt.	Per lamp-hour.	Per kilo-watt.	Per lamp-hour.							
1	.0805	.0146	.0284	.0186	.006	.0029			.0533	.0813	.0357	.0171	.1009	.0480	1009	.0480	Canandaigua	.121	.085	1
2	.0224	.0017	.0826	.0019	.0065	.0004			.0687	.0041	.0097	.0023	.1054	.0063	.9777	.0166	Holy	.081		2
3																				3
4																				4
5	.0125	.0041	.0125	.0041	.0167	.0054			.0418	.0186	.0281	.0085	.0679	.0321	.0679	.0321	Fort Plain	.116	.085	5
6	.061	.0864	.0616	.0290	.0225	.0074			.1651	.0638	.0622	.0268	.2473	.0805	.262	.0855	Frankfort	.115	.083	6
7	.0165	.0079	.0083	.0039	.0127	.0061			.0874	.0179	.0163	.0078	.0386	.0257	.0386	.0257	Watertown	.108	.038	7
8	.0166	.0075	.0194	.0083	.0179	.0066	.0038	.0018	.0566	.0272	.0294	.0141	.086	.0413	.086	.0413	Lockport	.054	.088	8
9																				9
10	.0247	.0118	.0843	.0165	.0054	.0026			.0645	.0809	.0315	.0151	.006	.0455	.0813	.0485	Unadilla	.077	.085	10
11	.0221	.0106	.011	.0053	.017	.0032			.0601	.024	.0163	.0078	.0654	.0818	.0654	.0818	Elmira	.084	.027	11
12	.0099	.0048	.0211	.0101	.0049	.0024			.0680	.0173	.0168	.0081	.0358	.0214	.0019	.0009	Boonville	.081	.089	12
13																				13
14																				14
15	.0091	.0044	.0118	.0067	.0125	.006			.0838	.016	.0286	.0113	.0569	.0873	.0685	.0873	Glen Falls	.053	.027	15
16	.0817	.0117	.0199	.0074	.0099	.0025			.0886	.0216	.0185	.0088	.0771	.0885	.0771	.0283	New Rochelle	.085	.083	16
17	.026	.0016	.0833	.0021	.0814	.0019	.0023	.0001	.085	.0057	.0874	.0022	.1324	.0079	.177	.0106	Boonville	.091		17
18																				18
19	.0828	.019	.0114	.0054	.0177	.0065			.082	.0249	.0901	.0144	.0381	.0834	.0821	.0894	Cortland	.091	.085	19
20	.029	.0139	.021	.0101	.0042	.002			.0544	.0251	.084	.0163	.0884	.0424	.0359	.0134	Lowville	.083	.04	20
21																				21
22	.0217	.0026	.0185	.0023	.0076	.0009			.0566	.0068	.0409	.0049	.0975	.0117	.0149	.0018	East Albany	.046		22
23	.0372	.0178	.0855	.0169	.0147	.0071			.0673	.0419	.0713	.0846	.1591	.0765	.1591	.0765	Gouverneur	.069	.088	23
24																				24
25	.0274	.0016	.0114	.0007					.0837	.0023	.0871	.0022	.0758	.0045	.083	.006	Chatham	.078		25
26																				26
27	.0696	.0227	.0848	.0113	.0164	.0054			.1309	.0894	.0681	.0108	.154	.0602	.216	.0704	Babylon	.101	.085	27
28																				28
29	.012	.0067	.0008	.0004	.0064	.0026			.0182	.0057	.0181	.0063	.0813	.015	.0813	.015	Hornellville	.059	.025	29
30	.0177	.0011	.0145	.0009	.0022	.0001	.0061	.0003	.0836	.0023	.0166	.0009	.0561	.0063	.0011	.0001	Mount Morris	.041		30
31																				31
32	.0276	.0182	.0257	.0133	.041	.0197	.0016	.0008	.0839	.046	.0511	.0945	.147	.0706	.176	.0854	Dobbs Ferry	.085	.031	32
33	.0146	.007	.0048	.0023	.0073	.0035	.0012	.0006	.0879	.0154	.0204	.0086	.0458	.0828	.0817	.0236	Alexandria Bay	.08	.089	33
34	.0142	.0068	.0071	.0084	.011	.0053			.0834	.0183	.0241	.0116	.0065	.0871	.0734	.0356	Ogdensburg	.123	.08	34
35	.0257	.0123	.0151	.0072	.0045	.0021	.0028	.0014	.0879	.023	.0885	.0143	.0774	.0871	.0774	.0871	Schenectady	.074	.084	35
36																				36
37	.0898	.0162	.0177	.0085	.0144	.0009			.0669	.0816	.089	.0187	.1049	.0603	.1049	.0603	Auburn	.066	.082	37
38																				38
39	.0688	.0042	.0044	.0021	.0068	.0033			.08	.0086	.0271	.013	.0471	.0226	.0471	.0226	Batavia	.069	.083	39
40																				40
41	.0648	.0311	.0488	.0237	.0617	.0296			.1764	.0846	.0623	.0826	.329	.124	.259	.134	Ithaca	.088	.029	41
42	.0272	.0180	.0189	.0067	.015	.0072			.0663	.0270	.0263	.0125	.0885	.0835	.0835	.0835	Utica	.07	.085	42
43																				43
44	.0246	.0081	.0172	.0066	.0864	.0119			.0782	.0235	.0813	.0102	.1033	.037	.187	.061	Brookport	.162	.08	44
45	.0274	.0181	.0185	.0065	.0101	.0045			.061	.0243	.0086	.0185	.0686	.043	.0896	.043	New York	.072	.083	45
46																				46
47	.0272	.0180	.0153	.0078	.0154	.0074			.088	.0273	.0854	.0122	.0894	.04	.0835	.04	Poughkeepsie	.083	.023	47
48	.0128	.0032	.0198	.0066	.0051	.0024			.0232	.0183	.016	.0036	.0023	.0023	.0023	.0023	Rome	.066	.083	48
49	.0259	.0124	.0083	.0039	.0435	.0034			.0738	.0603	.0188	.009	.1294	.0459	.1294	.0459	Canton	.095	.046	49
50	.0148	.0071	.0102	.0049	.0117	.0056	.006	.0029	.0428	.0216	.0414	.0108	.0642	.0038	.0642	.0038	Binghamton	.074	.083	50

* Letters denote subheads on Table No. III

of the operating expenses all four have been entirely eliminated in Table No. VI which makes a comparison of operating expenses between numerous American, German and English statistics.

The cost per k. w. for labor, fuel and supplies is shown and also the percentage cost of each. As Mr. B. J. Arnold in his valuable paper before the Northwestern Electrical Association¹ gave a table of percentage costs they have been placed on this table for comparison with others. From the low percentage of labor I imagine his costs were taken largely from incandescent stations. Attention must be called to the remarkable agreement of cost in the American municipal stations and the average of the English stations; and again to that of the six large American stations and the German average; both of the last two are equipped with large units in engines and dynamos, which probably accounts for the cost being lower than in the others.

There seems to have been little trouble raising money for lighting plants and at a comparatively low rate of interest in most cases; in but one instance, Chehalis, Wash., does it seem to have been necessary to offer inducements

lamps for city use only, the average is higher, being \$519.38 per k. w. or \$249.30 per 480-watt lamp. \$250 per arc lamp installed complete was formerly the price quoted by a large electrical manufacturing company. This is seemingly con-

TABLE VI.—COMPARISON OF OPERATING EXPENSES.

Nature of Station.	Labor		Fuel.		Supplies & Office.		Total Cost.
	per k. w.	% of total	per k. w.	% of total	per k. w.	% of total	per k. w. hour
14 American Municipal Stations.							
Contin. Cur. Arc.	.0251	42.9	.0173	29.6	.0161	27.5	.0585
5 American Municipal Stations Incandescent.	.0244	40.9	.0226	37.9	.0126	21.2	.0596
1 American Municipal Station Arc. New.	.0817	54.2	.0199	84.	.0069	11.8	.0585
6 American Stations. Mixed output of 5,300,000 k. w.	—	—	.0095	20	—	—	.0473
5 German Stations, output 1,907,900 k. w.	.0218	46.5	—	—	—	—	.0469
23 English Stations, avge. Crompton.	.0144	25.7	.0222	39.6	.0194	34.7	.0560
Ideal English Station, Crompton.	.004	15.	.0054	20.	.0170	65.	.0264
Lowest items in 23 stations Weaver.	.0074	19.8	.0126	33.8	.0173	46.4	.0373
Percentages. Mr. B. J. Arnold 129 stations. U. S. Census.	—	21.20	—	23.15	—	55.65	100.00
	—	43.71	—	21.16	—	35.13	100.00

TABLE V.
AVERAGE UNIT COSTS IN DOLLARS.

NATURE OF INSTALLATION.	No. of Stations.	Labor.		Fuel.		Supplies office.		Total operating.		Fixed charges.		Total cost.		Net cost to City or street lights.	
		per k. w.	per lamp hour.	per k. w.	per lamp hour.	per k. w.	per lamp hour.	per k. w.	per lamp hour.	per k. w.	per lamp hour.	per k. w.	per lamp hour.	per k. w.	per lamp hour.
Full arc lamps. City use only.....	14	.0251	.0121	.0173	.0083	.0161	.0077	.0585	.0281	.0399	.0163	.0926	.0444	.0825	.0444
Divided arc. City only.....	1	.0125	.0041	.0125	.0041	.0167	.0054	.0418	.0186	.0261	.0085	.0679	.0221	.0679	.0221
Incandescent Lamps. City and commercial.	5	.0244	.0017	.0229	.0016	.0136	.0009	.0536	.0042	.0337	.0005	.0864	.0067	.1107	.0068
Full arc lamps City and commercial.....	1	.0091	.0044	.0118	.0057	.0125	.0060	.0333	.0160	.0236	.0113	.0569	.0273	.0569	.0273
Divided arc lamps. City and commercial..	1	.0810	.0284	.0616	.0200	.0225	.0074	.1651	.0538	.0622	.0268	.2473	.0805	.2080	.0555
Full arc & incandescent. City use only....	2	.0239	.0115	.0130	.0062	.0122	.0058	.0400	.0235	.0220	.011	.0719	.0345	.0719	.0345
370 watt arc & incand. City use only.....	1	.0817	.0117	.0196	.0074	.0069	.0025	.0585	.0216	.0185	.0068	.0771	.0285	.0771	.0285
Full arc & incandescent. City & commercial	2	.0261	.0125	.0300	.0114	.0240	.0115	.0802	.0047	.0413	.0025	.1215	.0580	.1386	.0416
Divided arc & incand. City & commercial..	2	.0471	.0154	.0260	.0084	.0264	.0086	.0665	.0324	.0622	.0105	.1317	.0429	.1317	.0429
Full arc for City use. Arc & incand. for com' c'l	5	.0187	.0086	.0124	.0059	.0142	.0068	.0455	.0027	.0228	.0106	.0688	.0328	.0688	.0328

* Figures in upper line are costs per incandescent lamp hour.

trary to the commonly made statement that municipal plants are not bought as cheaply as private, said to be due in a measure to "jobs." Perhaps these "jobs" may be offset in the purchase of private plants by the commission sometimes paid some member of the company.

For incandescent plants, as shown in the third group of five stations, the cost is much lower, being \$258.91 per k. w. or almost exactly half of the cost for arc lamp plants. This also I believe accords with experience. The lowest price quoted for any kind of plant is that for Luverne, Minn., which is given as \$123.74 per k. w., or \$59.40 per arc lamp of 480 watts. The highest is for Alameda, Cal., where it is reported as \$986.84 per k. w., or \$473.68 per 480-watt arc.

The cost of the Chicago plant is also somewhat above the average but it is quite reasonable to suppose it is on account of high price of real estate and the fact that the wires are all in conduits. The price as per the report is \$774.13 per k. w. or \$371.52 per 480-watt arc lamp, which is really not excessive considering the above facts.

For the whole 36 stations giving figures of cost of plant,

6 cost between \$100 and \$200 per kilowatt.	
3 " " 200 " 250 " "	
3 " " 250 " 300 " "	
5 " " 300 " 350 " "	
4 " " 350 " 400 " "	
4 " " 400 " 450 " "	
3 " " 450 " 500 " "	
5 " " 500 " 600 " "	
3 " over 600 per kilowatt.	

Returning again to the highest and lowest cost of plant, it is interesting to compare the unit costs of output of each with the averages as shown in the first group of Table No. V.

TABLE VII.

	Cost of plant per k. w.	Cost per 480-watt arc lamp.	Labor per lamp-hour.	Fuel per lamp-hour.	General expense per lamp-hour.	Total operating expense per lamp-hour.
Luverne, Minn..	\$123.74	\$59.40	\$0.0048	\$0.0101	\$0.0024	\$0.0173
Alameda, Cal. ...	986.84	473.68	0.0311	0.0237	0.0296	0.0844
Av'ge, group 1...	519.38	249.30	0.0251	0.0173	0.0161	0.0585

to take the bonds, and in this case \$12,000 of bonds were sold for \$8000. This must be a poor town.

Comparing the cost of plant per kilowatt of capacity, the average for all where the figures are given, is \$383.83. Taking an average for the first group of stations, full arc

The comparison in Table VII shows most remarkable results. As no fixed charges are included in the figures it is rather strange that the cost per unit for the lowest priced station is so very much lower than the average, and indeed throws doubt on the accuracy of the Luverne report. It is quite usual to make extra expenditure in plant in order to lower the cost of operation, but in the case of Alameda, here shown, the high cost has seemed to act in just the opposite direction and likewise throws doubt on the accuracy of the figures.

Another comparison is that in Table VIII between the unit costs of lighting by municipalities and that of towns of similar nature supplied with similar service by private companies. The items will be found in Table IV and are for the first group of arc stations. In making this comparison, for the sake of the utmost simplicity only the price per lamp-hour has been used.

TABLE VIII.

Number of station.	UNIT COST PER ARC-LAMP HOUR.	
	Total cost for the output, city plants.	Total cost by private plants.
1	.0480	.055
7	.0257	.052
8	.0418	.026
19	.0894	.055
28	.0765	.083
29	.0150	.025
36	.0508	.032
39	.0226	.033
41	.1240	.029
42	.0395	.085
45	.0430	.082
46	.0400	.028
47	.0241	.083
49	.0308	.038
Averages.	.0444	.0358

The result, as shown in Table VIII, is somewhat surprising, as there is a difference of 20 per cent. in favor of the service supplied by private companies.

No effort was made to select towns having especially favorable contracts with private companies, as shown in Table VIII, but they were picked simply because they agreed nearest in size and similarity of service with the towns with which they are compared.

While the prices from private companies are fairly even, the greatest difference being between .055 and .025; the costs to cities owning plants varies in a much wider range, the lowest being .015 and the highest .124, the next highest being .0765.

The cost .015 per arc lamp hour is for Anderson, Ind. and is owing to the exceedingly low cost of fuel. The very high cost accredited to Alameda, Cal. seems to have been to all round heavy expense.

Assuming the figures in Table IV to be correct as stated therein, some rather queer results are shown by an examination of the cost per k. w. to the municipality after deducting the income from commercial lighting from the gross cost.

In Table IX. the costs per k.w. have been assembled for all stations reporting an income from commercial lighting and when the returns permitted of extension through the items in table IV.

The comparison has been made between the total cost per kw. for the total output of the station, the cost per kw. for city lighting after deducting the total income from the total gross cost; and the price per kw. to cities supplied by private companies. This table shows that the actual cost per kw. to a corporation is more where commercial lighting is furnished than where the city does its own lighting only; and is explained by the fact of extremely low prices for commercial work. Of course some

municipalities charge enough to overbalance the cost and in such cases the cost of public lighting will be much less.

TABLE IX.

Station No.	Cost per k. w. for total output.	Net cost per k. w. used by city after deducting incan. from commercial lighting.	Cost to city by private companies.
6	.2478	.2620	.115
10	.0960	.0913	.077
12	.0528	.0019	.081
15	.0569	.0565	.068
17	.1324	.1770	.091
20	.0884	.0259	.082
22	.0975	.0149	.046
25	.0758	.0630	.078
27	.1540	.2160	.104
30	.0561	.0011	.041
32	.1470	.1760	.065
33	.0488	.0617	.080
34	.0565	.0784	.123
44	.1095	.1870	.162
48	.0956	.1294	.095
Averages.	.1009	.1105	.086

The item of labor is the one division of operating expense in which it is claimed the greatest expenditure will be made in municipal plants. If the averages here shown may be considered accurate within reason, this belief is largely a myth for (with the exception of Chicago where labor is 53 per cent. of the operating expenses) the percentage for labor is less than usual in private plants. Either very low wages and very poor help are the rule or the item has been classed wrongly.

In all fairness it may be said that the much vaunted better management in private hands does not exist in fact, the men in charge of city plants comparing quite favorably with those in charge of private plants of similar size.

For the information of those not already acquainted with the fact, it may be said that copies of the *Census Report on Electrical Industries for the State of New York*, quoted in this article, may be had by writing to the Hon. Carroll D. Wright, Supt. of Census, Washington, D. C.

The writer has tried to avoid even the appearance of juggling with figures, and all results here shown are collated from data contained in the tables given.

Figures of a like nature are quite feasible for any station going, the writer having made them for stations having output of four or five styles of current, and for three consecutive years, the results agreeing in all essential points.

Until each and every station manager knows accurately the unit costs for his own work he has little chance in fighting the municipal plant.

Appended are a few of the comments accompanying the blanks as returned.

Comments.

Replying to yours of the 15th I would state in reference to same, that I would be pleased to coöperate with you on your municipal lighting question, provided I could assure myself of a fair treatment by you. I have attempted on several occasions to deal with you gentlemen, but have invariably found myself misquoted.

I have just taken charge of the plant here and they hav'n't taken record of anything, run it just as they could. The engineer let things run down so that they were just about ready to shut down. I have been working at it day and night, got it so it runs very well now.

The Mayor and all Councilmen, City Clerk and all Citizens of the city try to run the plant. The Waterworks and Electric Lights are run together. As the Mayor and Committee with the assistance of a leatherheaded clerk all dictate what shall be done and where supplies shall be bought, I therefore have no report to make. With eight years experience I would advise all towns to hire their lights which is by far the cheapest. After May 1st the plant may be more in a business way. I am not in favor of any city or town owning an electric light plant.

THE ELECTRICAL ENGINEER.

(INCORPORATED)

PUBLISHED EVERY WEDNESDAY AT

303 Broadway, New York.

Telephone: 3860 Cortlandt.

Cable Address: LENGINEER.

Geo. M. Phelps, President.

F. R. Colvin, Treas. and Business Manager.

Edited by

T. COMMERFORD MARTIN AND JOSEPH WETZLER.

Associate Editor: GEORGE B. MULDAUB.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue, Boston, Mass.

Western Editor and Manager O. KANNYER, 1439 Monadnock Building, Chicago, Ill.

New York Representative, 303 Broadway, } W. F. HANKS.
Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada, - - - - -	per annum, \$3.00
Four or more Copies, in Clubs (each) - - - - -	2.50
Great Britain and other Foreign Countries within the Postal Union - - - - -	5.00
Single Copies, - - - - -	.10

[Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1896.]

EDITORIAL ANNOUNCEMENTS.

Addresses.—Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of THE ELECTRICAL ENGINEER. Communications for the attention of the editors should be addressed, EDITOR OF THE ELECTRICAL ENGINEER, 303 Broadway, New York City.

Communications suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.

Advertisements.—We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers.

VOL. XVIII. NEW YORK, SEPTEMBER 5, 1904. No. 331.

CONTENTS.

EDITORIAL :—	PAGE.
A Municipal Lighting Plant Investigation.....	190
Better Times Here.....	191
Wholesome Doctrine.....	191
The Tariff.....	191
ARTICLES :—	
Public Lighting by Municipal Plants (with tables).....	HORATIO A. FOSTER. 181
Protection from Lightning.—II.....	ALEX. MCADIE. 192
ELECTRIC TRANSPORTATION DEPARTMENT :—	
Street Railway Earnings in Buffalo, O. and Columbus, O.—Trolley Trucking And Carting At Pittsburgh—King Casute in New Hampshire.....	192
General Electric Forty Ton Locomotive (illustr.).....	197
LETTERS TO EDITOR :—	
Magnetic Leakage with Toothed Armatures.....	193
.....ERNST J. BERG, CECIL P. POOLE.	
Iron Wire in Armatures.....	PROF. W. A. ANTHONY. 193
Testing Dryness of Steam.....	R. S. HALE. 194
PERSONAL :—	
W. S. Andrews.....	194
LITERATURE :—	
Hospitalier's "Formulaire de l'Electricien".....	194
Salomons' "Electric Light Installations." Vol. II.....	194
Trevert's "How To Build Dynamo Machinery".....	194
Maréchal's "L'Eclairage a Paris".....	194
Knot's "Electricity And Magnetism".....	194
Du Bois' "Magnetische Kreise, deren Theorie und Anwendung".....	194
LEGAL NOTES :—	
Storage Battery Litigation—Brush Elec. Co. vs. Elec. Stor. Batt. Co.....	195
OBITUARY :—	
G. B. Shaw.....	196
NEWS AND NOTES :—	
Chloride Accumulators In England.—Electric Lighting on the Chicago, Milwaukee & St. Paul R. R.—Search Lights on War Vessels.....	196
Stanley Apparatus in Canada.....	197
TRADE NOTES AND NOVELTIES AND MECHANICAL DEPARTMENT :—	
Immense Stratton Separators for the Phila. Traction Co.'s Plant (illustr.)—Ohio Brass Co.'s Motor Bearings (illustr.)—Western Notes.....	198
General Electric Double Reel Mine Hoist (illustr.)—Sales of Mather Apparatus.....	199
A Neat Interior Conduit Display Board (illustr.)—Western Notes.—New York Notes.—Southern Notes.—New England Notes.....	200

A MUNICIPAL LIGHTING PLANT INVESTIGATION.

WE publish in this issue the report of an investigation conducted this year by THE ELECTRICAL ENGINEER into the cost of installing, operating and maintaining municipal electric light plants. The movement in favor of such plants in some States has been active and enthusiastic, but, so far as we could discover, has been based on very uncertain data. It has seemed to us that setting aside the objection, on political grounds, to an increase of municipal functions and forces, the argument pro and con must rest mainly in the actual saving effected by a community in supplying its own wants. We have, therefore, as will be seen, taken special pains to collate very full information, and having secured it, have placed it in the hands of a highly competent and entirely disinterested expert Mr. Horatio A. Foster, who has carefully digested and analyzed our returns, has long been connected with the electric lighting industry and was specially attached to the electrical section of the last census. His work on central station bookkeeping is well known, and he has, it may be added, long made a study of central station costs. The returns could not have been placed in better hands.

The results of the investigation are very minutely set forth by Mr. Foster, and need not here be recapitulated. We will simply point out that in no respect do these figures justify the statements that have been made as to the superior economy of municipal plants. On the contrary, the private lighting companies operate more cheaply and when placed on a parity with the municipal plants as to taxation, etc., are able to supply a town with light as cheaply as it can supply itself. The conclusion might be stated even more strongly, but our readers can study the figures for themselves and draw their own conclusions.

As to the feeling in favor of municipal plants, we cannot say that we have seen many marked evidences of it lately. On the contrary, we come across utterances every day that point the other way. During the present week, we have received items from various quarters touching this very point. For example, we find the *Newark, O., American* saying:—"If the city authorities have in view the utter and complete destruction of our electric light plant, they are certainly pursuing the right course to accomplish that end." The *Hamilton, O., News* says: "By the way in which council seems determined to award the contracts for the new city electric light plant, the cost of the plant will be run up to about \$101,000. The people were assured originally that the plant would only cost \$50,000, and a great array of figures was presented to prove this fact." Speaking of the situation in Detroit, the local *Tribune* says:

After the lapse of one year the city finds itself with an elaborate white elephant on its hands. The people cannot fail to realize that the creation of the new department has simply increased the opportunity for more wrangling in the city government, and the facility with which private parties may control public affairs to suit themselves.

This the *Minneapolis Tribune* cites with approval, adding: "There are some people who are now scheming to saddle Minneapolis with a similar white elephant." The *Port Huron Tribune* remarks about that city:

Perhaps a little local competition would be better than for the city to go into the electric lighting business, which might develop several soft places for experimental favorites, for which the dear

city would have to foot the bills, and the taxpayer could stand back and take it out in growling.

Altogether these journals may be said to be inclined to agree with the *Des Moines Register*, that while municipal ownership may not be wrong in principle, and while the theory is very alluring, it is likely in practice, with the conditions now existing in city politics, to prove more disastrous than desirable.

We will only add that the large majority of these municipal plants are shown to exist in small places where the incentive of possible profit for a private plant is not at all strong. This fact will also serve to explain why these plants do not make a better showing. They are picayune and insignificant in most cases. At the same time, it does not follow that because a plant is small it is necessarily expensive to run. We hope shortly to publish an article showing how a small private plant for town lighting in New England is run, with a minimum of expense and a maximum of efficiency, two conditions which municipal plants evidently find it extremely difficult to combine.

One of the lessons of such an investigation is that few stations, whether municipal or private, appear to know what their actual costs are. If stations would make a practice of getting out their cost figures to a few places of decimals, we believe there would at once be a marked gain in efficiency and in dividend-paying power all over the country. A central station manager should be able to meet his fellows and at once tell, from a few minutes chat, whether his product is costing him too much, and whether the leaks in his power plant and office are not far worse than those on his line. Mr. Foster has given several hints as to the best way of getting at costs, classifying them and analyzing them, and while his impartial conclusions show that municipal figures might be much better, they also show that private plant figures are none too good. We trust that when the next opportunity offers itself for an analysis and comparison of such figures, both classes will be found greatly improved. It is not a bad thing for either that the other exists. All that is wanted is the truth as to their respective conditions of working; and with fuller knowledge there will certainly be less temptation to spend public money wildly and a better return on that which a popular sentiment has invested in electric lighting.

BETTER TIMES HERE.

THERE can be no doubt as to the revival of trade in this country. It may not be a "boom" and it is greatly to be hoped that it will not take that form, which is nearly as bad in the long run as a panic; but that there is better feeling and better buying nobody can question. The newspapers contain many indications of it. One of the best was mentioned to us last week by a leading official of a great New York paper which, he said, had on the previous Sunday had an increase of 70 Help Wanted advertisements, *all from firms needing employees*. A few days ago, an electrical contractor in this city informed us that in New York the coming winter would be the busiest in many years. Some four or five new buildings alone represented an investment of about \$10,000,000, and would keep hundreds of men active through the winter, while of miscellaneous work the quantity promised to be

unusually large. All such reports are very encouraging, and if the activity already prevailing throughout the South, thus spreads through the East and then is felt again in the West, we shall enter upon a new term of prosperity that the new tariff will but help to prolong and render memorable. Electricity in particular should feel the impetus of revived endeavor in the various branches of industry, and should prove a favorite field for conservative investment.

WHOLESOME DOCTRINE.

IN other columns we print the decision of Judge Green of the United States Circuit Court, District of New Jersey, denying a preliminary injunction, in the suit of the Brush Electric Co. *et al.* [Consolidated Electric Storage Co.] against The Electric Storage Battery Co. *et al.* This suit, as our readers will remember, was brought early in the current year to restrain the defendants from manufacturing and selling the Chloride accumulator, and the complainants alleged infringement of the Faure and Brush patents. The validity of the patents had been sustained by all the Courts and was not considered by the Court in the present case.

The wholesome doctrine maintained by Judge Green is, that the owners of a patent may not successfully invoke so drastic a measure as a preliminary injunction at the hand of a Court of Equity against defendants whose alleged infringement has been virtually acquiesced in by the complainants through inexcusable delay in asserting and enforcing their rights.

The Court found, moreover, that upon the testimony of the distinguished experts on both sides the question of infringement was left altogether too doubtful to justify an injunction. Judge Green was obviously much impressed by the diametrically opposite conclusions of the experts, in respect both to the scope of the patents and to the alleged infringement. "It must be apparent," said the Court, "that affidavits of this character, *ex parte* as they are, can only be productive of doubt." A severe and thorough cross-examination would be required to elicit the truth.

The reasons assigned by Judge Green for denying a preliminary injunction in this suit are based upon familiar principles of law. It is none the less gratifying to see them so clearly applied in a case like the present one, in which the defendants seem to have had every reason to assume immunity, not only through their confidence in the independence of their storage batteries from control by the claims of the Faure and Brush patents, but from the attitude of the complainants themselves until a late day. The defendants were open and above board in their business and more than a year ago invited suit.

The Tariff.

THE new tariff seems to contain no material changes directly affecting electrical industry or trade. Copper, not manufactured,—pigs, ingots, bars, plates, etc.—is made free; a change of no practical significance in view of the relation of American to foreign production of that metal. The duty of 1½ cents per pound—succeeding the former rate of 4 cents in 1890—if continued could hardly afford much support to another "copper combine" if attempted. The rate on copper sheets, rolled plates and rods is reduced from 35 per cent. to 20 per cent. The latter rate will probably serve to take care of the domestic manufacturers; if not, they know how to take care of themselves.

PROTECTION FROM LIGHTNING.—II.

BY ALEXANDER MCADIE, U. S. WEATHER BUREAU.

Beyond doubt, Franklin proved his case that lightning rods were efficacious in the protection of buildings. Buildings with conductors when struck by lightning suffered little damage compared with those without protectors.

The chief defects likely to occur are blunted points and breaks in the continuity of the connection. The function of a lightning rod is twofold; first, that of conducting the charge to earth, and second, the prevention of a disruptive discharge by silent neutralization of the cloud electrification. The latter explains why a rod terminates in a point and likewise why points in good connection with the ground are always *desirable* upon buildings. Indeed, points are somewhat like small water pipes connected with a large reservoir. If you have enough of them and a sufficient time you may drain the largest reservoir. Furthermore, when some sudden rise or flood occurs in the reservoir, these minute drains may be of service in keeping the height of the water down.

In the case of lightning the points are the small escape pipes, the layer of air between cloud and earth the retaining wall, and the cloud electrification—or charge—the overflowing and destructive element. A large conductor, be it rod or tape, on the other hand is more like a large main or water way, which has its gate shut until the flood is imminent. Then the gate is suddenly opened and we try to compel the torrent to keep to the provided path. We trust in its ability to safely hold the flood. Generally it does. In perhaps nine cases out of ten, the lightning conductor, if it be such a one as we will describe later, does carry the flash to earth; but there are cases where the discharges have been heavy and overflows have resulted. To carry the lightning flash "the lightning conductor should offer a line of discharge more nearly perfect and more accessible than any other offered by the materials or contents of the edifice we wish to protect." To prevent the discharge "the conductor should be surrounded by points." These quotations are from the Report of the Lightning Rod Conference.

The statement that lightning always follows the path of least resistance, as commonly understood and stated, needs modification. True it is, that when the air is strained by being subjected to the electrifications of cloud and earth, the weakest spot gives away first, and this is apt to be in line with some small elevated knob or surface; but it is equally true, and is perhaps the more general case, that when a really vigorous disruptive discharge does occur, it is somewhat, as Dr. Lodge aptly puts it, like an "avalanche." As a matter of fact, we find from the study of actual cases where buildings have been struck, that lightning often disregards entirely metallic surfaces and points. What we should first know is, whether the condition is to be one of "steady strain" or "impulsive rush" discharge. In the case of "steady strain," the metal is apt to influence the path of discharge; in the case of an "impulsive rush" discharge, even *points* seem to lose their efficiency and become of little use.

In a letter¹ of an old British admiral there occurred a description of his being called upon to approve some specifications for a lightning conductor to be erected on a certain lighthouse. He was himself a believer in the "surface" theory of Harris; but thought that, to make sure, he would go and consult his friend Faraday. Faraday, who saw only the question of conductivity in the problem, said very positively that the solid rod was better than the tube (which gives greater surface with less copper), and that *solid volume was everything*, superficial area nothing. Moreover, if Harris says otherwise "then, he knows nothing whatever about it." The admiral straightway approved the solid rod conductor for the lighthouse. Within two or three days he met Harris, and bringing up the question was told by Harris "surface area is most important, and if Faraday says otherwise, then he knows nothing whatever about it!"

Up to a certain point Faraday was right; a copper rod an inch thick is capable of carrying almost any flash of lightning, and is undoubtedly a great protector, but if, as we have reason to believe, the core is seldom given a chance to carry the current, why have it? The views of Sir W. Snow Harris, based as they were upon close study of many thousand cases of lightning action, are finding in the experiments of to-day the confirmation so long needed.

While not going into details regarding this question of the shape of the rod, let us emphasize the fact, so recently brought out, that if an electric current flows steadily in one direction in a cylindrical wire, its intensity is the same in all portions of the wire, as shown by Hertz, but that with a current of an oscillatory character, i. e., a current which rapidly reverses its direction, this condition no longer holds, and if the direction is alternated very rapidly, the interior of the wire, in our case the lightning rod, may be almost free from current.

In 1882 appeared the report of the Lightning Rod Conference; in many respects the most important contribution to the literature of the subject yet made. While so many foreign governments, and in particular France, had by means of officially constituted

boards, taken a governmental interest in the protection of the people from the dangers of lightning, the English-speaking people of the world, aside from the few directions officially issued for the protection of magazines and lighthouses, remained without any authoritative utterance upon the subject; and while this conference itself did not have strictly official sanction, it carries, from the character of its makeup, a weight certainly as great as, if not greater than, an official board. It was simply a joint committee of representative members of the Institute of British Architects, the Physical Society, the Society of Telegraph Engineers and Electricians, the Meteorological Society, and two co-opted members. As might be anticipated from such auspices, the report is an excellent one, and must stand for years as the embodiment of the most widely gathered information and well-considered decisions. The report is emphatically one based upon *experience*.

The famous free-for-all discussion which occurred at the British Association Meeting in 1888, so far as our judgment goes, simply proved that the decisions of the conference could not at present be disregarded. As the president of the meeting, Sir William Thomson, said, we have "very strong reason to feel that there is a very comfortable degree of security, if not of absolute safety, given to us by lightning conductors made according to the present and orthodox rules."

There are one or two further features to which attention may be called. There are some very prevalent misapprehensions with regard to lightning. For example: that it never strikes twice in the same place; that the most exposed place is always struck; that a few inches of glass or a few feet of air will serve as a competent insulator to bar the progress of a flash that has forced its way through a thousand feet of air, etc. These are alluded to in the following general directions.

STREET RAILWAY EARNINGS IN BUFFALO, N. Y., AND COLUMBUS, O.

THE July statements of the Buffalo and the Columbus street railway companies make a good showing, especially the latter. Its gross earnings for the month were \$51,287, an increase over the same month last year of \$1,404, but as the management succeeded in reducing operating expenses \$5,280 to \$23,924, net earnings increased \$6,634 to \$28,363. These figures indicate that it is possible, to operate electric lines at less than 50 per cent. of the gross income. For the year to the end of July, the Columbus Company's gross earnings aggregated \$315,560, an increase of \$5,114, compared with the corresponding period last year, while operating expenses decreased \$48,092, thus making an increase in net earnings of \$53,207. The earnings of the Buffalo lines for July are not quite so favorable, as gross earnings decreased \$7,489 to \$139,797; but as operating expenses decreased \$8,124 to \$73,607, there was an increase in net of \$684 to \$66,189. Gross earnings for seven months were \$366,964, an increase over the same period last year of \$32,014, while operating expenses decreased \$36,213 to \$498,741, leaving net earnings at \$368,222, an increase of \$68,227.

TROLLEY TRUCKING AND CARTING AT PITTSBURG.

A NOVEL attempt to apply electric power in the work of constructing an electric railway has been successfully put in operation at a point near Guyasuta by the Citizens' Traction Company, on their electric branch road to Guyasuta. It was found necessary to erect a bridge and make several cuts and fills in the new road bed at a point near Aspinwall. A common gravel car was fitted up with a powerful motor, and trolley wires were hung along a temporary track leading to a hollow a short distance back of the road bed. The connection was made with the current at the terminus of the line at Guyasuta, and sufficient power was thus obtained to propel the car loaded with gravel and clay into the hollow mentioned. By this means the work was greatly expedited, and it is said that the experiment gave very satisfactory results.

The place was visited by a large number of contractors who have had large experience in the construction of steam and electric roadways. They were much pleased with the results they saw accomplished, and many expressed their intention of adopting a similar plan upon the next occasion they could put it into practice. It is claimed that the adoption of this plan enabled the contractors to complete their work in about one half the usual time required for such a contract.

KING CANUTE IN NEW HAMPSHIRE.

IN New Hampshire the great fight before the next Legislature will be over franchises to electric roads. The steam roads will fight it, and all are united on that issue. The electricians have so many advantages in operating cost, no right of way to buy, no stations to maintain, no terminals to acquire, that they can carry passengers for distances under 10 miles much cheaper than the railroads. Suburban roads are feeling the competition severely.

1. Terms used by Prof. Lodge.

2. See report of Lightning Rod Conference.

LETTERS TO THE EDITOR.

MAGNETIC LEAKAGE WITH TOOTHED ARMATURES.

IN the discussions at the recent Philadelphia meeting of the American Institute of Electrical Engineers, I saw a statement made by Mr. A. E. Wiener on the phenomenon of core leakage as a disadvantage of toothed armatures. At that time I paid no further attention to it considering this statement to be a typographical error since in designing or testing I never met any such phenomenon.

As however, Mr. Wiener in the last issue of THE ELECTRICAL ENGINEER advances a theory of what he calls core leakage, I cannot refrain from submitting a few critical remarks.

On Page 142, Mr. Wiener states:

"(b) *Toothed and Perforated Armature.*"

"In toothed and perforated armatures a portion of the magnetic lines of the main path enters the iron projections of the core, and passes through the armature without cutting the conductors. This portion, therefore, can not be considered as useful, and has to be taken into account in computing the total leakage coefficient of the machine * * *."

I can hardly think that Mr. Wiener really means that the flux passing through the tooth into the armature core is ineffective and thus only the flux passing through the slots is active. I therefore must interpret the paragraph as meaning that part of the flux passes from tooth to tooth outside of the conductor thus reaching the other pole without cutting the armature conductors.

While it is theoretically possible that some lines take that path, a simple consideration will show that this fraction of the flux is infinitely small compared with the total. Assuming for instance, the ratio of the width of the slot to the pitch on the outer circumference to be .5, and the magnetic conductivity of the iron in the armature as low as 800, we have, as half of the circumference is iron and half air, that the magnetic resistance of this leakage path per unit section is more than 150 times as high as that of the armature circuit. Since however, the armature core has a much larger cross section than the leakage cross section, it is obvious that this factor must be a very small fraction of a per cent.

Mr. Wiener gives, however, in this case 1.3 to 1.35 as the leakage factor; therefore calculations based upon these core leakage factors must lead to quite erroneous results.

ERNST J. BERG.

SCHENECTADY, N. Y., August 24, 1894.

THE writer read with great interest the opening section of Mr. A. E. Wiener's article on "Magnetic Leakage in Dynamo-Electric Machinery" in your issue of the 22nd inst., but cannot understand Mr. Wiener's statement (page 142, sub-section (b)) to the effect that, "in toothed and perforated armatures a portion of the magnetic lines of the main path enters the iron projections of the core and passes through the armature *without cutting the conductors*. This portion, therefore, *cannot be considered as useful*, etc." (The italics are mine.)

If the lines of force entering the teeth do not cut the conductors in the slots, what becomes of them as the armature revolves, carrying given teeth beyond their reach? Of course, if the armature remained stationary with relation to the field magnet, the lines of force entering the teeth would not cut any conductors, but it is entirely obvious that when a given tooth moves through any given angle the lines of force which entered that tooth at the instant prior to its moving are necessarily transferred to the teeth following, and in passing from tooth to tooth they are compelled to cut the conductors between; the magnetic flux certainly does not draw in its horns, so to speak, during the passage of an armature conductor and wait until another tooth comes along to jump across to the core!

Considering the lines of force as a tangible fluid, which is entirely permissible in this particular case, an armature conductor occupying at one instant a position just ahead of a given line of force entering a certain tooth cannot get on the other side of that line of force without passing through it. If Mr. Wiener's argument were correct there would be no object whatever in using toothed armature cores; the reluctance of the true air gap (from his standpoint) would be double what it would be without the teeth and the teeth would operate exactly as so many pieces of iron placed across from pole to pole outside of the armature, but not quite touching the pole pieces,—a conglomeration of useless and extravagant magnetic short circuits.

To use teeth for driving the armature conductors mechanically would, under such circumstances, be suicidally extravagant, because in armatures where the width of each tooth is about equal to the width of a slot *one-half the total flux from the field magnet would be waste!* True Mr. Wiener's table giving the core leakage in toothed armatures does not claim such an amount of leakage, but even his table charges the teeth with a waste of 20 per cent. of the flux where the teeth and slots are of equal width.

The writer's experience has certainly not so far demonstrated such an exorbitant waste incumbent upon the use of toothed

armature cores, and he is entirely unable to see how any of the lines of force passing from the polar faces to the armature core can fail to cut every conductor on the surface of the armature, during each revolution. Perhaps Mr. Wiener's statement is not correctly construed.

CECIL P. POOLE.

LYNCHBURG, VA., Aug. 27, 1894.

IRON WIRE IN ARMATURES.

My attention has been called to some discussions upon the above topic, and I think it is one well worth careful consideration. The idea first occurred to me some years ago when the first suggestion of the "iron-clad" armature appeared, that the same advantages might be obtained by winding the armature with iron wire at a considerable saving of expense as compared with the plan then proposed of making holes through the core near its circumference and threading the conductors through them. But as soon as the experiment of using iron-clad armatures was tried it was found that sparking at the commutator was enormously increased and that it was necessary to increase the air gap in order to control the sparking. As the air gap required is, however, in a small machine, less than the space required for the copper wire in a surface winding a saving is effected in the field magnet windings by the use of slotted armatures. Whether the same, or a greater, saving could be made by using iron wire as a surface winding, and at the same time reducing the cost of the machine, is a question that can only be settled by making a design and a careful computation, and it cannot be finally settled without trial.

I wish to point out, however, a few considerations that seem to have been overlooked. It will require to wind an armature for the same resistance, approximately six times as much weight of iron as of copper. How much less will this cost when wound with cotton for magnet wire? The iron will occupy seven times the space on the ends of a Siemens armature or on the inside of a Gramme ring. The iron wire being larger will be more difficult and more expensive to wind upon the armature. If the winding consists of more than one layer, as is always the case with small machines, not all the magnetic lines will pass through the area enclosed by the lower layers; in other words, the lower layers of wire will not cut all the lines of force, and will not generate their full quota of E. M. F. Especially would this be true if the pole horns were lengthened, as has been suggested.

And here I would point out that lengthening the pole horns is not to be considered as increasing the effective length of the armature conductor. Every turn on the armature cuts all the lines of force that pass through the armature core, and the effect of lengthening the pole horns is to increase the number of lines, not in proportion to the increase in length, but in proportion to the diminution in the total reluctance. If the iron conductor is of considerable depth, more lines would pass through the parts near the surface and so produce different E. M. F.'s in different parts of the same conductor, giving rise to wasteful eddy currents. If there is to be any gain in the use of iron wire it must be in producing a more efficient or a less costly machine. I cannot see how there can be any less loss in the iron wire armature for the losses from hysteresis and eddy currents would be increased, and to make the $C^2 R$ loss less, the iron wire would need to be more than seven times as large as the copper.

The only place where any saving in the waste of energy can be effected is, it seems to me, in the field, and there the question is, whether the air-gap can be reduced so as to reduce materially the total reluctance without rendering the sparking unendurable. And supposing this can be done, we must still bear in mind that in a well designed one horse-power machine as now made, the energy required to excite the field is not more than three per cent., and a reduction of this by one-third will only effect a gain of one per cent. in the efficiency of the machine. If it is necessary to increase the size of the machine in order to dissipate the heat generated there is certainly a loss instead of a gain of efficiency.

As to cost, I cannot see, in view of the considerations I have already advanced, how there can be any reduction. The armature I am sure would cost more. The insulated copper wire now used on small machines cannot cost more than six times its weight of insulated iron wire, and it would certainly cost more for labor to wind the armature with the iron wire.

As to the use of iron wire in winding the field cores, it might seem, since the winding itself might be considered as a part of the magnetic circuit, that the cores could be diminished in size and the length of wire much reduced; but it must be remembered that, as the several turns of the field winding must be insulated from each other, considerable reluctance will be introduced into the useful circuit by the multitude of little air gaps, and, considering the increased leakage from the shorter air space between iron and iron and the little leakage paths around the individual wires, I think it will be found that very little if any reduction could be made in the size of the core, and that the iron wire would, in consequence of its greater specific resistance need to be larger and longer.

WM. A. ANTHONY.

NEW YORK, Aug. 23.

TESTING DRYNESS OF STEAM.

IN Mr. Peabody's letter in the *ENGINEER* of August 15 he shows that water of condensation will get into a collecting nipple placed in a horizontal pipe. In my case a nipple in a vertical pipe in an ascending current of steam showed as wet steam as the throttling calorimeter would measure for over twenty minutes, and readings of the separating calorimeter during this time showed over twenty per cent. The action appeared steady, not intermittent, and the boiler was steaming at only a little below its normal rate, as estimated from the decrease of height of the water in the gauge glass, the feed being shut off. It hardly seems possible that the nipple should collect only water from the passing current and, in any case, there appears to be no chance for over a quart or so of water of condensation to collect in the pipe, much less than that shown by calorimeter. Every time I have tried I have been able to stop the wet steam by boiling the water down to an inch or so in the gauge glass, for which I can see no reason if the wet steam was due to water condensed in the pipe.

I have made a number of evaporation tests on this boiler. In only three tests was the heavy priming frequent enough to make the average very bad. Calorimeter readings were taken every thirty minutes. For thirteen tests the average priming was 3 per cent.; average evaporation corrected for priming, 9.87 per pound of combustible from and at 212 degs. For three other tests the priming was 9 per cent., evaporation 10.43 pounds, corrected for priming. These figures certainly indicate that the priming was more, instead of less, than that shown by the instruments.

As to reading 6 per cent on a throttling calorimeter, if Mr. Peabody will calculate the priming for 160 pound gauge pressure, atmospheric exhaust and no superheat in escaping steam, he will find, if he uses Regnault's data, that the percentage of moisture is 5.8 per cent., or roughly 6 per cent. If he wants to read over 6 per cent., he may either increase the steam pressure, or he may connect the exhaust to a condenser.

I shall be very glad to be convinced that the wet steam I find is always due to water of condensation in the pipes and intend making further experiments to, if possible, finally determine this point; but for the present must continue to believe that my boiler will at times prime 20 per cent. or more.

R. S. HALE.

BOSTON, MASS.

LITERATURE.

Formulaire de L'Electricien. By E. Hospitalier. Paris, 1894. G. Masson. 386 pp. 4 x 6½ in. Flexible Covers. Price, \$1.25.

M. HOSPITALIER's electrical pocket book is so well known as to scarcely require extended mention. This edition has been fully brought up to date and we note a number of changes which the ever-varying art has made necessary. The chapter devoted to transformers and accumulators, especially, has been considerably extended, and that devoted to distribution has been increased in usefulness by figures giving the calculation of the resistance and the impedance of conductors subjected to alternating currents. There is also new matter relating to polyphase currents and figures relating to distribution of power by this method. The constructional data given of three-phase motors built by various concerns abroad will prove of interest to many. Likewise the tables giving the data of the various types of railway motors, including the usual geared motors, the direct-connected locomotive used on the London underground road, storage battery cars, etc. The table for converting French, i. e., metric units into units of other systems is calculated to save much labor.

Electric Light Installations. Volume 2. Apparatus. By Sir David Salomons. Bart, M. A. New York. D. Van Nostrand Co. 1894. 8vo. 818 pages, 296 illus. Cloth. Price \$2.25. (Seventh Edition).

It is a pleasure to note the continued success enjoyed by this handy, practical, useful treatise, which has now expanded by natural growth into three parts,—the first dealing with accumulators; the second, and present, with apparatus used in isolated plants; and the third, to come, with methods of working. In this book Sir David, with his familiar directness and pleasant simplicity of style, discusses engines, dynamos, lamps, fuses, governors, etc., describes various good types, and throws in, quite casually, as it were, a lot of that shrewd observation and sound common sense that is so refreshing in all that he has to say about his favorite avocation and which is generally so marked by its absence from books written to instruct the public. If the book has any fault it is shown in the author's anxiety not to overlook any piece of apparatus that may be of interest or use, but to which he has not the space to devote for helpful detail. We suggest that American readers can get from this book an excellent idea of the kind of apparatus in vogue in England and of its points of difference from our own.

How to Build Dynamo Machinery. By Edward Trevert. Bubier Publishing Company, Lynn, Mass., 1894. 339 pp. 6 x 8½ in. Price, \$2.50.

THIS book is intended to aid those who, without caring to go into deep calculations, are in quest of data for the construction of dynamo machines. Thus we find descriptions, with scale drawings, covering machines from a toy motor up to a 20-light dynamo, and also a 1,000-watt alternating current machine. To this are added descriptions and illustrations of the principal types of direct and alternating current machines now in use, and directions for the management of dynamos and motors, and practical directions for armature and field winding. The volume will prove useful to amateurs.

L'Eclairage a Paris. By Henri Maréchal. Paris. Baudry & Co. Cloth. Quarto. 496 pages. 211 illust. Price, \$3.50.

This large and interesting book deals exclusively with the history of artificial lighting in Paris, treating the subject from the technological standpoint rather than the chronological. It may be said that the proper public lighting of great cities began with the plans carried out in Paris, in 1667, since which year that centre of European gayety has remained one of the most brilliantly illuminated capitals of the world. As the title of the book would imply, it is chiefly with the production of light and of light giving mediums that M. Maréchal deals. For detailed information on apparatus and novel or curious lamps or candelabra, one must turn to the pages of D'Allemagne's sumptuous "*Histoire du Luminaire*," but in the volume now before us, the author discusses gas works and central stations, and brings together a vast amount of data on the division of the city into sections, methods of distribution, rates charged, and special isolated plants. A final chapter touches lightly upon oil and candles and makes a few notes as to luminous fountains.

Electricity and Magnetism. By C. G. Knott, D. Sc., F. R. S. E., Philadelphia. J. B. Lippincott Co. 8 vo., 239 pages, 175 illus. Cloth.

This book has been prepared by Prof. Knott in behalf of students entering for the first stage or elementary examination of the Science and Art Department, in England, and should answer that purpose admirably, as well as subserve the needs of many other primary students. It is clear and sequential in its treatment of the subject, and the exercises with which each chapter closes are such as to bring to any intelligent mind a sharp realization of the lesson that it has been the endeavor to convey. Each chapter also has a summary, committing which to memory will greatly help the student. Portions of the text of a more advanced nature are printed in smaller type, so that when the student makes a review, he can also aim his thoughts a little higher than before, and be strengthened for deeper investigation. On the whole this little book is well up to date in theory, and is one of the best of its class.

Magnetische Kreise, deren Theorie und Anwendung. By H. du Bois. Berlin, 1894. Julius Springer. 382 pp. 5½ x 8 in. Price \$3.

THE volume before us is an extension of a paper read by the author before the Electrical Congress at Frankfurt, in 1891, entitled "Magnetic Circuits and Their Measurement." The work is divided into two parts. The introductions are elementary in their nature and the author has refrained from a minute description of all results of experimental investigations in this field, in view of the previous publication of Ewing. Indeed, he assumes the reader to be cognizant of these results and bases upon previous theoretical investigations the science of the magnetic circuit, as the fundamental type of which he discusses the radially slotted ring.

The second part of the work, in contradistinction to the purely theoretical and scientific method employed in the discussions of the first part, treats the subject from the standpoint of applied physics. Chapter VI. is devoted to the general properties of magnetic circuits, and Chapters VIII and IX consider the application of the principles elucidated to the principal machines and apparatus employed in the arts or in the laboratory, including the main types of dynamo machines now employed in practice. In this part the author has introduced the various apparatus and methods for determining the magnetic properties of iron, including the latest forms of Ewing's apparatus.

We can heartily recommend this book, not only to students, but to all practically engaged in the design of electro-magnetic apparatus. It supplements admirably the able work of Ewing.

MR. W. S. ANDREWS, has resigned the management of the Lancaster, Pa., and other central stations and taken a position with the General Electric Company in Schenectady in close connection with the same class of work.

LEGAL NOTES.

STORAGE BATTERY LITIGATION.

THE BRUSH ELECTRIC CO. ET AL. vs. THE ELECTRIC STORAGE BATTERY CO. ET AL.—MOTION FOR A PRELIMINARY INJUNCTION DENIED.

BELOW is the opinion in full of Judge Green, rendered August 27, in the above entitled case involving the right of the defendants to manufacture the Chloride accumulator.

UNITED STATES CIRCUIT COURT, DISTRICT OF NEW JERSEY.

WITTER & KENYON, for Complainant, JOHN R. BENNETT, for Defendant.

Green, J: Two reasons conjointly compel a denial of the motion for a preliminary injunction, made by the complainants.

The validity of the Letters Patent in question is beyond dispute. They have been sustained by all the Courts, before which they have been the subject of litigation. The only question to be considered upon this motion, under the circumstances, is that of infringement. While it is well settled that a preliminary injunction will issue, almost as a matter of course, in any given case wherein the defendants are shown to be guilty of infringement, after an adjudication establishing the validity of the Letters Patent involved in the litigation, yet it is equally well settled that to warrant and justify the exercise of this extraordinary power, the proof of the alleged infringement must be clear and decisive. Equity peremptorily insists that such action so drastic in its effects shall be taken only in those cases wherein a clear, unclouded, equitable right to the interference of the Court is shown: in all other cases the demand is to be met by refusal. Otherwise unfair prejudgment may result.

In the case at bar the proof of infringement fails to attain to this standard. It is quite true that, on the part of the complainants, certain gentlemen, most eminent in their profession, and whose opinions, as experts, are entitled to great weight, have not hesitated, in their affidavits presented to the Court upon this motion, to assert quite positively that not only the storage battery manufactured by the defendants, but as well the process used in the manufacture, do without doubt infringe some, if not almost all, of the claims of the Letters Patent under consideration; and they laboriously strove to justify the opinions so expressed, first, by giving to the Letters Patent and the various claims an exceedingly broad construction; and, secondly, by basing such broad construction upon a yet broader construction of the legal conclusions of the learned judges, who have in past litigations defined and characterized the inventions of Faure and Brush.

Giving full weight to the opinions of these witnesses, elucidated and most eloquently enforced upon the attention of the Court in the exceedingly able argument of counsel, it still remains to be said that the defendants have, in opposition thereto, presented opinions of other scientists, equally as learned and of equal standing and repute in the scientific world, which are directly antagonistic thereto, and by which they most distinctly and positively declare that in their judgment neither the process pursued by the defendants, nor the completely manufactured battery impinges in the slightest particular upon those secured to the complainants by their Letters Patent. And so upon the one side are found the concurring opinions of Prof. Morton and Prof. Chandler, Prof. Houston and Dr. Barker; upon the other, those of Prof. Brackett, Prof. Cross, Prof. Thomson and Mr. Van Size. These are gentlemen of unquestioned veracity; thoroughly understanding the subject matter under consideration; stating opinions with confidence which they believe to be well formed, and yet they arrive at conclusions which are irreconcilably and diametrically opposed. It must be apparent that affidavits of this character, *ex parte* as they are, can only be productive of doubt. When the statements so made and the opinions so expressed come to be tested by a severe and thorough cross examination, beyond question, those which show themselves securely founded upon reason and fact will be immediately accepted and concurred in. But until then, the existence of a doubt, well founded and reasonable, as to the right of the complainants to the remedy they ask, cannot be overlooked. The existence of such doubt, must now at least, control the action of the Court. It is fatal to a motion for a preliminary injunction. To justify the interference of a Court of Equity, *pendente lite*, by way of an injunction, the actual or threatened infringement of a right must appear as clear as the noon-day sun.

There is another reason why this motion must be denied. Equity demands of a complainant that he should display great diligence in the assertion and vindication of his rights. Inexcusable delay on his part, though it may not amount to conclusive proof of acquiescence, nevertheless may be, and often is, sufficient

cause to disentitle him to the summary interference of the Court on his behalf by way of interlocutory injunction. Whatever may be the original equities of the case, as between the parties, if the complainant stands quietly by, without seeking to enforce his rights, while the defendant expends time and labor and money upon the enterprise sought to be enjoined, upon faith that no actual or effective objection thereto will be made, he will be shorn of any right to appeal to a Court of Equity for assistance. *Hummer v. Hummer*, 2 Green (Ch) 268. *Whitney v. Union* 6, 11 Gray 359. *Carlisle v. Cooper*, 21 N. J. Equity 599.

In other words the principle has been thus stated: "No one can have relief if his own conduct has led to that state of affairs which occasions the application."

The proofs submitted to the Court, on this motion, show these facts. The defendant corporation was organized under the laws of the State of New Jersey in 1888. Its sole purpose was to engage in the manufacture and sale of electric storage batteries, of the type known as the Chloride accumulator. Its works were located at Gloucester in this State; and from the time of its incorporation to the present, it has carried on its business without interruption. Its existence and the character and extent of its operations were well known to the principal officers and managers of the complainant corporation. In the conduct of its business at various times and especially in 1891, 1892 and 1893, the defendant openly installed storage battery plants of the alleged infringing type in various public buildings, and for various corporations. Thus, for example, they furnished plants, or batteries, to the Provident Insurance Company of Philadelphia; to the Metropolitan Railway Company of Washington; to the Union Square Theatre in New York, and elsewhere. The fact that these plants were furnished by the defendants was well known to the complainants. Besides, early in 1893 the defendants issued a pamphlet in which was printed an opinion of Prof. Chandler, of Columbia College, on Storage Batteries, and which contained a detailed and correct statement of the mode of construction and operation of the storage batteries of the defendants, and a full and succinct comparison between them and the batteries of the complainants. This pamphlet was widely circulated; and admittedly the complainants knew of it. In July, 1893, the defendant, through its President, sent to the complainant corporation a letter in which, among other things, is the following statement and appeal:

Philadelphia, Pa. July 27, 1893.

MR. WILLIAM BRACKEN, President Consolidated Electric Storage Co., New York, N. Y.

Dear Sir:—I am favored with copies of your letters of 27th February and the 24th of July, 1893, to Mr. George W. Pearson, President of the Metropolitan Railway Company, of Washington, D. C., wherein you state that the battery manufactured by The Electric Storage Battery Company, of Philadelphia, is a clear infringement of the Brush patents, and of which there is no earthly doubt.

By what authority do you say our battery infringes the claims of your Brush patent? Surely on the authority of no Court for you well know that no Court has declared our battery to be an infringement, and although we have been, to your knowledge, openly engaged in manufacturing our batteries for some years, you have not, down to this moment, proceeded against us, although threatening to do so for nearly eight months past. You apparently propose to dispose of our battery and business without even resorting to the Courts wherein such questions are usually determined.

Unlike you, we have sufficient confidence in our position to submit the question to the courts empowered to consider and determine such questions, and there we invite you to meet us at once, and unless you do so, or discontinue your libellous statements against our battery, we will take such steps as we are advised are open to us to protect our interests.

We are advised by our counsel and experts that our battery does not infringe any of the claims of your patents, and having confidence in their opinion, we propose to continue making and selling our battery, and shall protect and save harmless all users of them, not only as against any claim you may make, but against all claims from whatever source.

Now, being advised of our intentions, we demand, in view of statements made in your letter to Mr. Pearson, and other parties, that you proceed at once against us on a bill of infringement accompanied with motion of injunction so that the question of our infringement of your patents may be determined, and to that end we advise you viz:

We are a New Jersey corporation with a factory at Gloucester in that State, where batteries are being manufactured daily, and we will at any time furnish you with one of our batteries, at the usual price, accompanying same with a sworn statement of precisely how they are made, with permission to use the same in any proceedings against us.

We have, to avoid delay, authorized our counsel, Mr. John R. Bennett, Potter Building, New York City, to accept service papers in our name and to aid you in every way possible to reach the courts at the earliest possible moment, and you can arrange with him either direct or through your counsel for one of our batteries and a statement of its construction.

If you have confidence in your position you will, of course accept our most reasonable proposition to proceed against us at once, and if you do not we hereby notify you that we shall proceed against you to protect our interests, holding you responsible for the damage resulting to our business by the making of statements and the sending out of such unfounded libellous letters as you have sent to Mr. Pearson.

To this letter the complainants returned no answer beyond a mere acknowledgement of receipt; and, admittedly took no action toward the assertion of their claim until months after.

In the meantime, the defendant, assuming, as it cannot be denied they had reason to do, that no attack was to be made upon them, increased their capital stock \$250,000, and proceeded to erect in addition to their existing factories a very extensive plant, at a very large cost. It was not until 1894, months afterward, that this bill of complaint was filed. Realizing the necessity of making explanation of their delay the complainants allege that it was caused first by their diligent searching for some

purchaser of the defendants' storage battery within the jurisdictional limits of the Circuit Court of the United States for the District of Southern New York, in which forum much of the previous litigation concerning the Brush and Faure batteries had taken place, and so avoid, by the bringing of their suit in that jurisdiction, some of the trouble and labor which would necessarily follow the commencement of a suit in this jurisdiction; and, further, that all the operations of the defendants were considered by the complainants to be simply tentative in the line of producing a practical commercial storage battery, and only an effort on the part of the defendants to persuade the complainants to spend thousands of dollars in substantially a moot litigation, to stop the making and sale or use of only a few batteries; and because the complainants believed the venture of the defendants was destined to be a failure and die a natural death.

It is hardly necessary to say that such excuses do not justify the laches of which the complainants have been clearly guilty. If the rights of the complainants are now trespassed upon by the defendants, they were in like manner trespassed upon more than four years ago; and the trespass, of which so loud complaint is made now, has been continuous. For reasons satisfactory to themselves the complainants, well aware of these continuous trespasses, chose to stand by, without taking action looking to the vindication of their rights, and the prompt punishment of the trespasser. The result of such inaction on the part of the complainant is found in the increased contribution to the capital stock of the defendant corporation, of hundreds of thousands of dollars, and the expenditure of an exceedingly large amount of money in the erection of greatly extended plant. If, in fact, the rights of the complainants have been invaded by the alleged infringing acts of the defendants it is scarcely an exaggeration to say that the dilatory conduct of the complainants, in protecting their rights, amounted to open encouragement of, or, at least, to silent acquiescence in such invasion. Such conduct bars absolutely the remedy asked for, at this time, by the complainants. *Brisbin v. Burdick*, 12 Beavan, 1. *Smith v. S. W. Railway Co.*, Kay, 417.

It was admitted upon the argument that the defendants were financially responsible, and amply able to respond to any award of damages that might be made against them. Under all the circumstances and for the reasons given the motion for a preliminary injunction is denied.

CHLORIDE ACCUMULATORS IN ENGLAND.

IN view of the decision quoted in our Legal Notes, in regard to this form of accumulator, our readers will be interested to hear that the Chloride Electrical Storage Syndicate, Limited, sole manufacturers in that country of the Chloride accumulator are now operating the street railroads of Birmingham, England, with Chloride accumulators, replacing the Epstein batteries which were formerly in use. The Chloride cells operate at least 60 miles on every charge, and, it is asserted, could do 80 miles if it were necessary, thus enabling each car to be operated with one set of batteries instead of two, as has been the practice heretofore. The English Chloride Company has also supplied batteries to Messrs. Mather & Platt for use on the trolley road on the Isle of Man running between Portevada, the Douglass terminus, and the Laxey terminus. The *Electrical Engineer* of London, in a recent issue describing this road says: "One of the most noteworthy features in connection with the line is the use of accumulators. At Groule Glen, situated two and a half miles from Douglas, a battery of 240 cells has been erected in a building specially constructed for the purpose. These cells were manufactured for Messrs. Mather & Platt, Limited, by the Chloride Electrical Storage Syndicate, Limited, of 16 Victoria St., London. They have a capacity of 140 amperes for three hours, or 70 amperes for nine hours, and are remarkable for the exceedingly level curve of E. M. F. which they maintain up to the end of discharge, and for the very high rate at which they can be discharged without detriment. Half the cells of the battery are of the Chloride Company's patent protected type, with teak separators and asbestos diaphragms similar to those now being used on the Birmingham tramways, and the other half unprotected. The cells are charged direct from the line or from a motor generator, which is of special design by Messrs. Mather & Platt, which gives the required additional E. M. F.

This is the first instance of accumulators being used as a fixed battery for tramway or railway work in this country, although a similar step has been taken in the case of the Zurich-Hirslanden tramway referred to in the *Electrical Engineer* of July 20, last. The battery at Groule Glen serves not only the function of supplying the extra power required at times of maximum demand, but it is intended during the Winter months to work the light cars, which will then be sufficient for the traffic after the close of the tourists season, entirely from the battery, which will be charged only once or twice a week as occasion may require."

The same Company recently equipped the electric launch "Aphrodite," the following description of which is taken from the *London Electrical Review* of August 17: "On Saturday last the

Goring-on-Thames regatta was held, and the new electric launch "Aphrodite" was lent to the Thames Conservancy for the occasion, and was employed for clearing the course during the day. The novel feature consists in the employment of a battery of Chloride cells for the first time on the Thames, and this launch has been specially built in order to demonstrate their superiority for this class of work, their large capacity for a given weight enabling distances and speed to be run without recharging, which were previously impossible. The cells with which the "Aphrodite" is fitted are capable of being discharged at a very high rate, and, on the measured mile, a speed of nine miles per hour has been obtained, and this rate can be continuously maintained for about three hours, which is a record performance for an electric launch of this size; at slower speeds, namely, $6\frac{1}{2}$ miles per hour, which is the usual rate of travel, which is still considerably above the average speed of electric launches of this size, a day's run of nine hours can be undertaken, inclusive of the time taken through locks."

ELECTRIC LIGHTING ON THE CHICAGO, MILWAUKEE & ST. PAUL R. R.

IN the paper read by Mr. M. B. Leonard at the meeting of the Association of Railway Telegraph Superintendents, on "The Electric Lighting of Railway Trains," and printed in *THE ENGINEER* of Aug. 1, reference was made to the system developed by Mr. Geo. Gibbs and used on the through trains of the Chicago, Milwaukee & St. Paul.

In the end of the car next to the tender of the engine is placed a small Westinghouse engine of 18 horse power, directly connected with a 12 kilowatt dynamo, and taking steam from the boiler of the locomotive through an overhead coupling like those used for the heating pipes on this road. The cars are all wired on the "return loop" system, thus making the length of circuit (positive and negative together) to any one lamp in the train the same as that to any other lamp, no matter what the length of the train may be, and greatly decreasing the difficulty of keeping the candle power uniform throughout the train. At the end of the car by the side of the door is placed a small switchboard with the necessary switches and instruments for the measurement of current and voltage, and near it a small rheostat for regulating the candle power of the lamps.

Arrangements are made at Milwaukee by which current is taken from the passenger station lighting plant while locomotives are being changed. This is readily accomplished by placing a flexible cord connection from the station mains in a convenient position to be reached from the buffet car when the train stops.

As the throttle of the small engine is closed a switch is thrown, transferring the load to the station circuit. When the locomotives have been changed, the steam connections made and the engine and dynamo brought up to speed, the load is again transferred and the connection with the station circuit broken. By this means it is possible to keep up the light continuously without the aid of storage batteries,—an important feature.

SEARCH-LIGHTS ON WAR VESSELS.

It appears that search-lights were indiscriminately used during the recent English naval manoeuvres, the result of which in the case of actual war would probably be disastrous to vessels belonging to the same nation. For instance, the night alarm early on August 6 at Belfast, when the Red squadron imagined that they were being attacked by Blue torpedo boats, shows the danger there would be in war time of friendly ships firing into each other amidst the confusion of a night attack, and also the necessity for greater discretion in the use of electric search-lights.

OBITUARY.

G. B. SHAW.

WE regret to announce the death of ex-Congressman G. B. Shaw, of Eau Claire, Wis., at that city, in the fortieth year of his age. He was born in New York State in 1854, and at an early age removed to Wisconsin where he became engaged in the lumber industry. As a strong Republican he was elected mayor of Eau Claire in 1888 and he was also elected to the Fifty-third U. S. Congress from the Seventh District of Wisconsin. He was an enthusiastic fraternity man, and from 1890 to 1892 held the position of supreme chancellor for the world of the Knights of Pythias. A few years ago he became actively connected with the National Elec. Mfg. Co. of Eau Claire and later on was to some extent connected with the Electrical Supply Co. of Chicago. All who had the good pleasure to meet Mr. Shaw will receive the news of his early death with deep regret and sorrow.

GENERAL ELECTRIC FORTY TON LOCOMOTIVE.

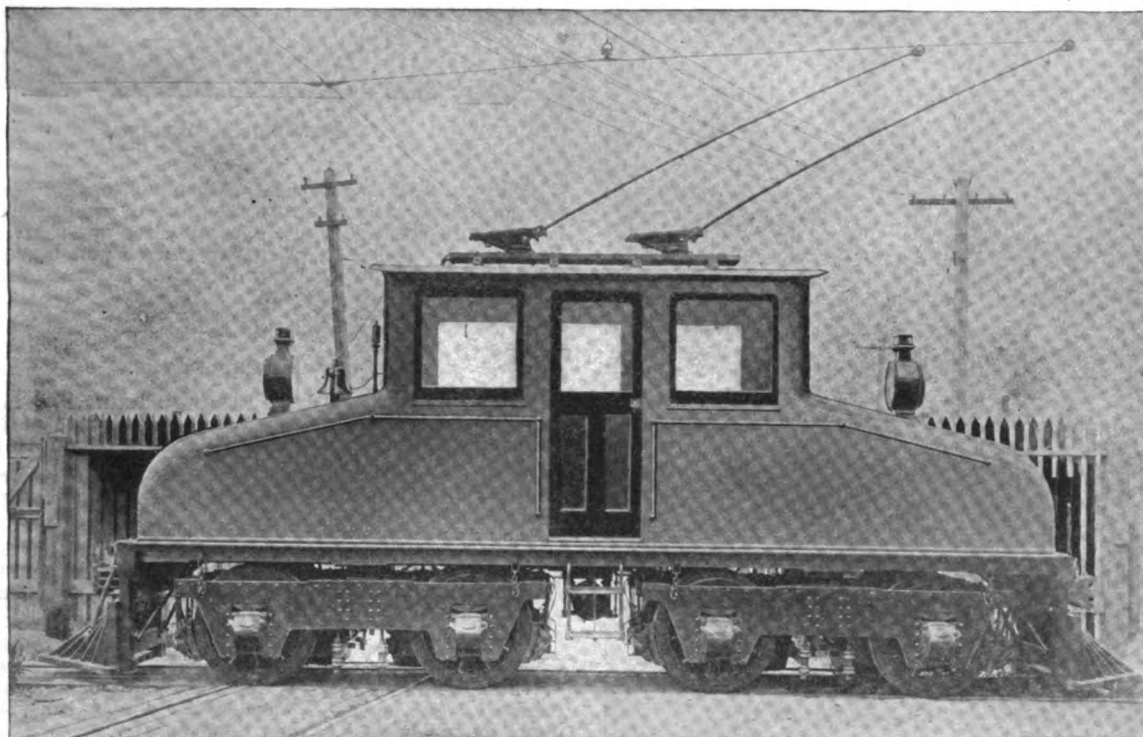
Our readers will recall an interesting description, published among our articles on the electrical exhibits at the Chicago Exposition, of a thirty ton electric locomotive built by the General Electric Company. From thirty tons and one two motor truck to forty tons and two motor trucks is but a step, and the General Electric Company have only recently made it. This forty ton locomotive is now standing in the factory yard at Lynn and, as will be seen by the illustration is an imposing electrical engine.

It is designed to perform the ordinary work of a steam locomotive of similar capacity where excessive speeds are not considered requisite, up to about thirty miles an hour. It is made up of two similar but independent trucks each having four wheels. Each pair of wheels is driven by its own specially designed motor of the single reduction spur geared type, mounted upon the axle as in ordinary street car practice. The truck frame is constructed of plate iron and channels designed to obtain at the same time both strength and simplicity. The entire weight of the frame including the cab is carried on elliptical springs resting directly on the top of the journal boxes. This suspension secures easy riding and minimizes the wear both of the locomotive and the truck. The journal boxes are of cast iron with phosphor bronze bearings hydraulically pressed in. Lubrication is provided for by means of a large well for oil and waste. The box slides in jaws

STANLEY APPARATUS IN CANADA.

THE STANLEY ELECTRIC MANUFACTURING CO. have recently made a contract with the Montmorency Electric Power Co., Quebec, Can., for furnishing them with three 675 H. P. two-phase generators, which will be used for conveying the water power of the famous Montmorency Falls to the city of Quebec for light and power purposes. The Montmorency Falls, eight miles from Quebec, are famous the world over for their beauty. The Fall altogether is over 300 feet, there being one perpendicular fall of 268 feet. For the past ten years this water power has been used for supplying light in Quebec, the present plant consisting of three 2,000-light alternators, made by the Royal Electric Co., Montreal, and fifteen arc light machines with a total capacity of 600 lamps. These present alternators are single phase and run at 1,800 volts at the Falls, delivering 1,000 volts at Quebec, and simply supplying ordinary lighting service. The Montmorency Co. decided a short time ago to put in a modern plant.

The three large machines which they have bought of the Stanley Company will generate a potential of 5,500 volts; the output of each machine will be carried on four wires to a sub-station in Quebec where step-down transformers will reduce it to 2,000 volts and the distributing system through the town will be at this potential. One thousand K. W. capacity of Stanley step-down transformers will be employed for this purpose, which will be

**GENERAL ELECTRIC FORTY-TON LOCOMOTIVE.**

protected by adjustable shoes to take up the wear. The journal bearings being outside, all parts are easily accessible for purposes of inspection and repair, and to ensure against any bending caused by hard usage, the axle and journals are made large.

The cab rests on the truck in a manner somewhat similar to that in which the ordinary passenger car is mounted, an ample margin for wear and strength being provided. The cab itself is constructed of sheet iron and the windows in it are so arranged as to give an almost unobstructed view from one position in all directions. The design of the cab is such as to give plenty of available floor space without making the top of the cab long enough to obstruct the sight. The design of the cab also makes a symmetrically shaped locomotive. The electrical equipment comprises besides the motors, a series parallel controller, an air compressor, which provides air for the brakes and whistle, and the automatic safety devices. In addition there are bells, head lights and sand boxes.

The dimensions and features of this locomotive are as follows: Weight, 40 tons; draw bar pull, 14,000 pounds; height over all, 11' 8"; length over draw bars, 24'; width over all, 8' 4"; wheel base of single truck, 6'; diameter of drivers with 8" steel tires, 40"; number of drivers, 8; size of journals, $4\frac{1}{2} \times 8$ "; gauge 4' 8 $\frac{1}{2}$ ".

placed in a sub-station built purposely for their reception with very complete arrangements for keeping the transformers cool by air blasts.

The current will be used for lighting, general power distribution by two-phase alternating motors and for running street railways by the use of rotating transformers. In the sub-station there will also be a very complete switchboard installation. There will be one switchboard for the railway service, one for the arc-light service and one for the two-phase light and power service. The offices of the company will also be in the same building. The drop in the line between the Falls and the sub-station will be 6 per cent.

The progressiveness of the company and its success is largely due to the able management of the General Manager of the Montmorency Co., Mr. F. H. Badger. Mr. Badger is a son of the city electrician of Montreal and was with the Royal Co. for ten years. He connected himself with the Montmorency Co. on February 1, 1894, and is very careful and thorough, being an electrical engineer of more than ordinary acquirements.

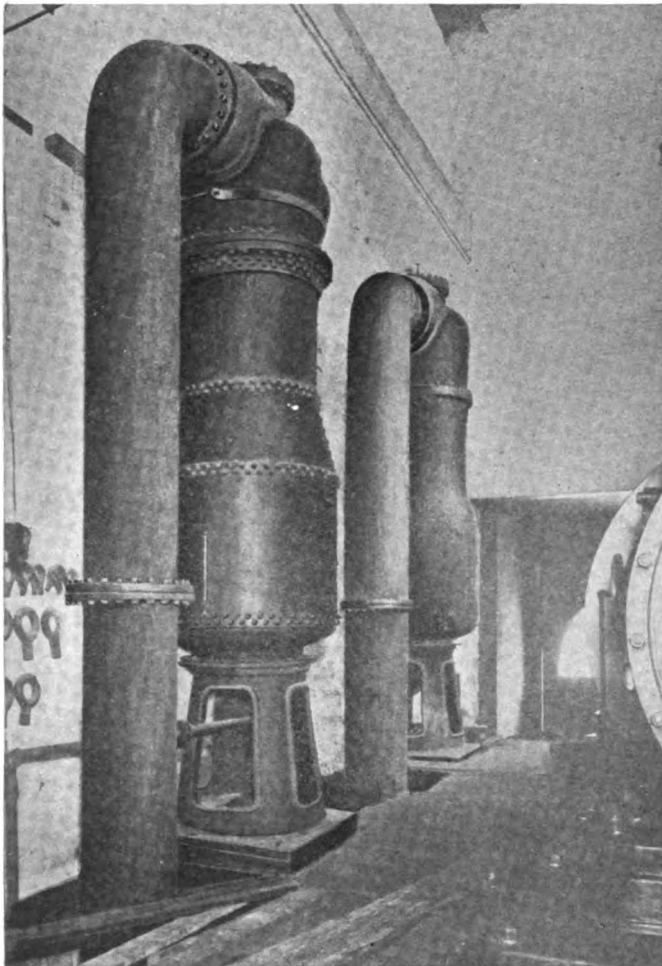
MR. R. L. WARNER, of the Westinghouse Electric and Manufacturing Co., has left Portland, and has taken a position in the main office in Pittsburgh.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

IMMENSE STRATTON SEPARATORS FOR THE PHILADELPHIA TRACTION COMPANY'S PLANT AT PHILADELPHIA.

THE cut herewith shows two of a total of six Stratton steam separators all of unusually large size recently furnished by the Goubert Manufacturing Company, New York, to the Philadelphia Traction Company for their new power station at 18th and Mount Vernon Sts., and 38rd and Market Sts., Philadelphia. The Goubert company has become famous for the number of large separators and feed water heaters it has built, and this latest installation takes rank with any already noticed, if indeed it does not exceed in the individual size and aggregate number, all previous installa-



STRATTON SEPARATORS, TRACTION CO.'S PLANT, PHILADELPHIA.

tions to which we have from time to time drawn attention. Of the six Stratton separators in the Philadelphia plant, two are 18 inch, two 16 inch and two 8 inch. One of the 18 inch separators is seen in the fore-ground of the engraving.

The Stratton steam separator is based upon the principle that if a rotative motion is imparted to the steam, all the liquid particles it may contain, being heavier than the steam, acquire centrifugal force and are projected to the outside of the current. It consists of a vertical cylinder with an internal central pipe extending from the top downward, for about half the height of the apparatus, leaving an annular space between the two. A nozzle for the admission of the steam is on one side, the outlet being on the opposite side, or on top, as may be most convenient in making the connections. The lower part of the apparatus is enlarged to form a receiver of considerable capacity, thus providing for a sudden influx of water from the boiler. A suitable opening is tapped at the bottom of the apparatus for a drip connection, and a glass water gauge shows the level of the water in the separator at all times.

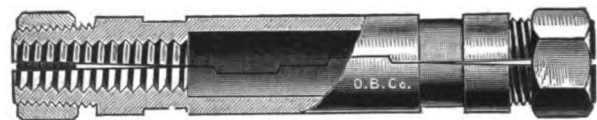
The current of steam on entering is deflected by a curved partition and thrown tangentially to the annular space at the side

near to the top of the apparatus. It is thus whirled around with all the velocity of influx, producing the centrifugal action which throws the particles of water against the outer cylinder. These adhere to the surface, so that the water runs down continuously in a thin sheet around the outer shell into the receptacle below, while the steam, following a spiral course to the bottom of the internal pipe, abruptly enters it, and in a now dry condition passes upward and out of the separator, without having once crossed the stream of separated water, all danger of the steam taking up again such water after separation being entirely avoided.

It is of interest to add that the Goubert Manufacturing Company have also supplied Goubert feed water heaters of the latest improved type for the new plants of the Philadelphia Traction Company, aggregating 12,000 horse power.

OHIO BRASS CO. MOTOR BEARINGS.

The superior workmanship and quality of the metal which the Ohio Brass Co. of Mansfield, Ohio are employing in the manufacture of railway motor bearings, has resulted in a large increase in their sales of these articles, and they number among their patrons many of the largest roads in the country. These bearings are made of a guaranteed bell metal, and are turned and trued up and



NEW MOTOR BEARING.

milled by special machines lately installed for this purpose. The extraordinary care taken with the finish of these insures a perfect fit, and an even and smooth bearing for the shaft. The Ohio Brass Co. have prepared a revised price list of bearings and the figures at which these are now offered to the trade will no doubt largely increase their output.

WESTERN NOTES.

THE JACKSONVILLE, ILL., ELECTRIC LIGHT AND POWER COMPANY has been incorporated with a capital stock of \$100,000, by Samuel H. Trude, George B. Stafford and William H. Lee.

THE WASHINGTON ELECTRIC COMPANY, Chicago, are receiving some very flattering testimonials in regard to their stage dimmers, the sale of which they report as increasing.

THE METROPOLITAN ELECTRIC COMPANY are having considerable call for their Kester commutator compound, station engineers finding it useful in the preservation of the commutator and prevention of sparking.

FORD, THOMAS & REID is the style of a new firm in the electrical engineering field in Chicago. They will make a specialty of elevator lighting and safety appliances, and all three having been engaged in the electrical business for a long time, they will no doubt make a success of their new venture.

MR. PAYSON K. ANDREWS, at one time with the J. G. Brill Car Company, but more recently western manager of the American Car Company, died suddenly in Chicago on August 22. Mr. Andrews was well known among street railway and electrical people as a successful salesman and made a host of friends. His remains were sent East for interment.

THE ELECTRIC APPLIANCE COMPANY have been experiencing a very satisfactory trade during the month on their two wire specialties: Parante rubber covered for inside work and "O. K." weatherproof for line work. Numerous large orders have been received and coming as they do so early in the season certainly promise well for a handsome fall trade.

MR. A. H. GOODE, for the past two years Chicago representative of the Jenney Electric Motor Company, has accepted a position with the Central Electric Company, where he will have charge of their constantly growing motor department. Mr. Goode's experience in the electric light and power field has been considerable, and he will no doubt prove a valuable acquisition to the company's staff.

THE METROPOLITAN ELECTRIC COMPANY have received some good orders for I. X. L. triple braid wire, among the number being one for thirteen miles and one for ten miles, large sizes. This wire is coming into prominent notice in the west, being already a favorite in the east, and the Metropolitan Electric Company carry a large supply always on hand to enable them to fill orders without delay.

GENERAL ELECTRIC DOUBLE REEL MINE HOIST IN A SOUTHERN SILVER MINE.

THE introduction of electrical apparatus into mines where steam or compressed air machines have been tried and found wanting goes on apace, either as auxiliary machinery or as the main machinery upon which the entire operation of the mine must depend. An interesting installation has recently been made by the General Electric Co. in a silver mine in the South, in which electrical apparatus plays a very important part.

The generating plant situated at the mouth of the mine consists of two engines. These are connected through friction clutches to a common shaft carrying a band wheel, and each engine operates one D-62 General Electric generator having 500 volts potential and 85 horse-power output.

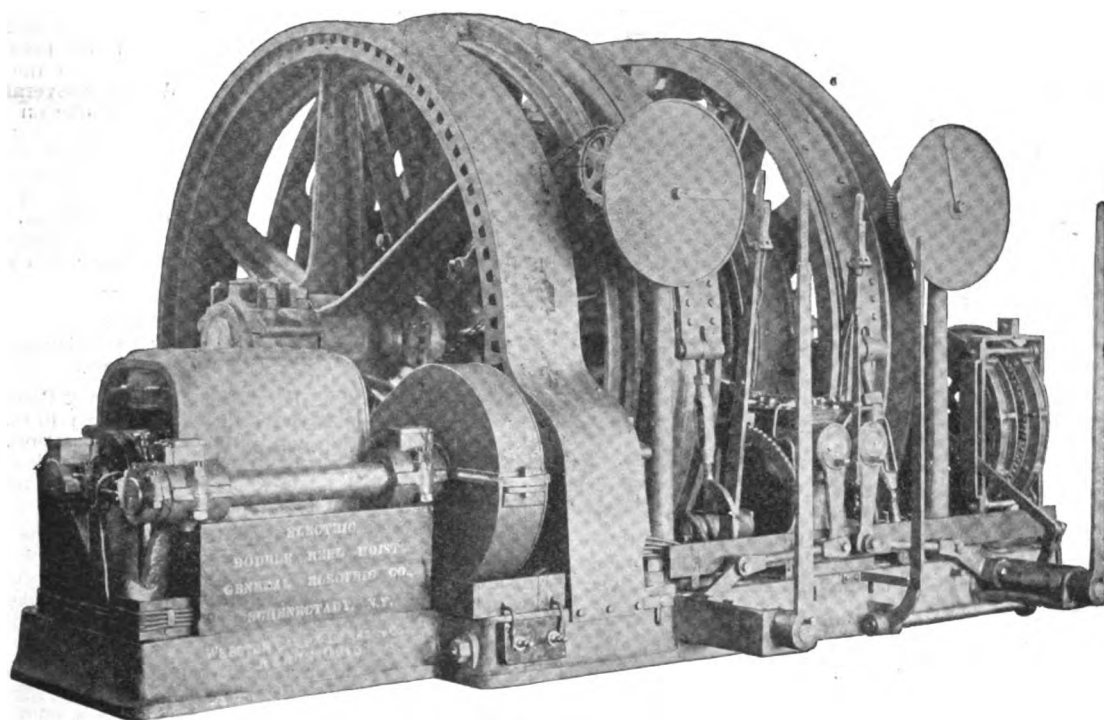
The power house also contains a separate McIntosh & Seymour high pressure engine operating an arc dynamo of 18 lights capacity and a 150 light incandescent dynamo. The pulley upon the common shaft is to be used to operate a third D-62 generator as soon as the extensions in the mine warrant the addition, while a 500-light alternating plant which is also to be installed will be run from a separate engine, and will supply light for a town about two miles distant.

The current is carried from the power house to the tunnel of the mine and the various shafts over insulated copper wires. At

On account of the direct relation between the working diameter of the reel and the weight of the rope unwound which forms a considerable part of the load, the work done by the motor remains practically constant.

When the load is started from the bottom of the mine, the weight of the rope, about 2,500 pounds, is added, but it is being wound on an 18 inch radius. When the load nears the top, only the ore and the skip are being lifted and the winding radius has increased to 48 inches. The average speed of the intermediate shaft is 200 revolutions per minute, which gives a starting speed to the car at the bottom of the mine of 400 feet per minute and at the top 600 feet. The regulation is therefore automatic.

The entire weight lifted from the bottom is about 5,500 pounds, —2,000 pounds of ore, 1,000 pounds of skip, and 2,500 pounds of rope. The reels are loose on the shaft, the hubs having brass bushings which may be readily renewed when worn. To each reel is cast on the side a polished clutch ring five feet in diameter, and upon this is fitted a Webster, Camp & Lane band friction clutch, the ring keyed upon the shaft. This clutch is of improved type, and has been extensively used by the Webster, Camp & Lane Machine Co.; indeed, it forms one of the special features of this hoist. By its means, the load may be started at any point without jerking; or the load may be released and allowed to come to rest when the hoist is running at full speed. The clutch has wooden faces which can easily be replaced when worn.



GENERAL ELECTRIC DOUBLE REEL MINE HOIST.

shaft No. 1, 1,000 yards from the mouth of the mine, two hoists have been installed, one of the single type, operated by a 16 H. P. motor, the other of the double reel type, as illustrated in the accompanying engraving. At a distance of about a mile from the station is shaft No. 3, which is equipped with a 25 H. P. single drum hoist. Shaft No. 1 still retains its steam hoist and is provided with a small direct connected plant of the marine type.

The large electric double reel flat rope hoist illustrated, is probably the largest ever made and has just been completed by the General Electric Company. It nominally works in balance and has a capacity on each side of 5,000 pounds, the mean speed of the rope being 500 feet per minute. The motive power is furnished by a General Electric 125 H. P. motor of the L. W. P.-20 type similar in size to the large ones used to propel the cars of the Intramural Railway. The lower frame of this motor is provided with feet, which allow of its being bolted to the bed plate of the hoist. The maximum demand on the motor will be about 80 H. P. when the hoist is working singly. Under normal conditions, that is, when it is hoisting in balance, the demand will be about 50 H. P.

The hoist itself is extremely compact; the dimensions of the base, exclusive of the motor, are 9½ feet square, the width being increased by about 3 feet 4 inches by the addition of the motor. The height is about 7¼ feet above the foundations, the reels, however, extending a little below the level of the bed plate. The reel centres are 4 feet apart, and have a capacity each of one thousand feet of flat rope ¾ in. by ¾ in. The diameter of the naked reel is 8 feet; this when wound with the rope is increased to 8 feet.

The brake rings are keyed to the reel and are 7 feet 6 inches in diameter, with an 8¼ inch face. Each is designed to allow for expansion of the brake when lowering, which heat may bring about. The reel shaft is of steel 6 inches in diameter, the journals being increased to 8 inches at the centre, and run in bearings babbitted and adjustable. The indicators on the front show the position of the cages. The weight of the hoist complete is about 3,200 pounds and no part is so large but that it can be lowered into a mine, the tunnel of which is 7 feet by 8 feet.

SALES OF MATHER APPARATUS.

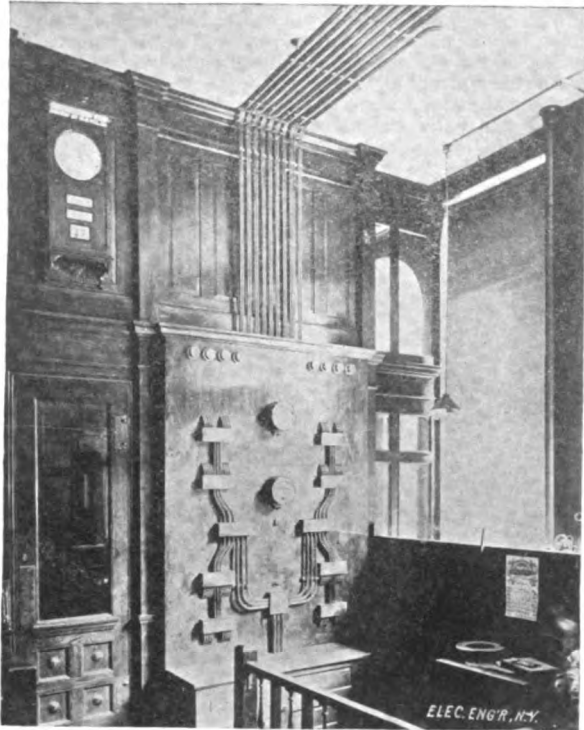
THE MATHER ELECTRIC COMPANY OF Manchester, Conn., report the shipment last week of a car-load of electrical apparatus, consisting of one 250 light dynamo and ten 3 H. P. Manchester type slow speed motors, with special starting boxes, to the Massachusetts State Insane Asylum at Danvers: the motors will be used for operating ventilating fans throughout the building; the whole installation being in the hands of G. M. Angier and Company of Boston, New England contractors for Mather apparatus.

They also report the sale, through Harry S. Smith and Co. of Philadelphia, of two 45 k. w. direct connected dynamos for the Bartram Apartments of that city. These dynamos are to be of the new Mather multipolar type, directly connected to Woodbury engines, and when completed will be one of the finest direct connected plants in Philadelphia.

A NEAT INTERIOR CONDUIT DISPLAY BOARD.

THE CENTRAL ELECTRIC CO., Chicago, have just completed a very attractive display or switch board, showing the application of the Interior Brass Armored Conduit. Our illustration gives a good view of the same, showing the various appliances, such as feeder and junction boxes, elbows, tees, switches, cutouts, etc. The board and its appliances are used for distributing current throughout the Central Electric Co.'s establishment, the mains entering at the back of the board and being distributed thence by means of branch lines to the different parts of the store.

The board was gotten up under the direction of Mr. Charles G.



CENTRAL ELECTRIC Co.'s DISPLAY BOARD.

Burton, in charge of the interior conduit department, and the highly polished tubing mounted on a well-finished hard-wood board makes a very handsome appearance in the already attractive store of the Central Electric Co.

NOT ENJOINED.

THE statement made by the *Marlboro, Mass., Times*, quoted by us recently, to the effect that the Bryan-Marsh Co. had been enjoined from manufacturing lamps, appears to have been made wholly in error. The Company has not been enjoined, and no change whatever has occurred in its relations to the trade.

WESTERN NOTES.

THE OHIO STORAGE BATTERY Co. has been formed at Cleveland, O., with a capital stock of \$100,000.

MESSESS. JONES & LAUGHLINS of Pittsburgh, are constructing a new roll shop in connection with their mills, and have ordered from the Morgan Engineering Co. of Alliance, Ohio, one of their standard construction traveling cranes, all motions of which are operated by electric motors. The lifting capacity of the crane is 15 tons, and the span about 40 ft.

THE NORTHWESTERN ELECTRIC LIGHT & POWER COMPANY, at Chicago, made an assignment on August 21 to William L. Abbott. The assets are estimated at \$66,450, and the liabilities at \$66,866.79. The failure is said to be due to competition on the part of the Edison Company. It is said to be the present intention of the assignee not to carry on the business.

MESSESS. PIERCE & RICHARDSON, Chicago, are sending out a neatly printed circular announcing the fact that they are now permanently located in their new offices, 1409-10 Manhattan Building. In addition to a general electrical engineering business, they make a specialty of testing and inspecting power and lighting stations and reporting thereon. Both members of the firm have had a wide experience in the field and are well qualified to execute work of any kind in electrical engineering.

THE JAMES LEFFEL & Co., of Springfield, Ohio, have issued a fine and complete new pamphlet, illustrating and describing their well-known line of upright and horizontal steam engines and steel boilers, with latest improvements, which were awarded a diploma and medal at the World's Fair. A copy may be had free on application to the company. It is well worth sending for by any one needing an engine or boiler.

THE GROWING POPULARITY of the Packard-Mogul is something to which the Electric Appliance Co. as general Western agents point with considerable pride, as they have practically been the means by which this desirable specialty has been introduced to the Western trade. The demand for the Packard-Mogul has been increasing rapidly and steadily from the first, and almost every expectation as to its wide field of future usefulness is being realized. It is now coming into quite general use for street lighting for which work it possesses many advantages, and the coming winter will undoubtedly see it quite extensively used for that work.

ODD ATTEMPT TO COMMIT SUICIDE.—Some men are struck by lightning, some pick up a live wire through ignorance, and some are officially electrocuted, but it remained for a Chicago man to distinguish himself by becoming the first man to deliberately choose the electric current as a means of committing suicide. Charles C. Hoffman, a tinsmith, had been out of employment for some time, and to add to his misery, he said he was jilted by Kate Gallagher. Without work, without money and without a wife, he no longer desired to live, and having heard that the current of an arc light is strong enough to kill a man instantly, he decided to "electrocute" himself. He chose the arc light in front of No. 59 Halstead street and dragging several empty boxes from a neighboring store and piling them one on the other, he erected a platform from which he could reach the carbons of the lamp. He did so and was thrown a distance of fifteen feet, tipping the boxes to one side as he fell in a heap on the pavement. Two police officers who witnessed the act called a patrol wagon and Hoffman was conveyed to the county hospital. After dressing his seared hand, the physicians discharged him, and he will probably be in a condition to repeat the attempt in a few days.

NEW YORK NOTES.

MR. H. C. WHITNEY, has resigned his position as a motor salesman for the Interior Conduit & Insulation Co.

MR. A. A. CARY, M. E., of the Abendroth & Root Manufacturing Co., has, we regret to learn, been seriously ill for some weeks with appendicitis, and had to undergo an operation. He is now recovering, and his return to professional duties is eagerly looked forward to by his business associates and his many personal friends.

MR. S. W. RUSHMORE, of 126 Liberty St. has increased his facilities at his Jersey City factory for the manufacture of his high tension arc lamps, by the addition of several special machines. He has discontinued the manufacture of the constant potential arc lamps, having sold his patent rights to the General Incandescent Arc Light Company.

THE BARRIETT ELECTRIC MOTOR AND DYNAMO Co. has just completed a 100 light plant at the Colonial Club, installed a steam engine to drive exhaust fans and furnished a complete plant at O'Neill & Co.'s large dry goods store. The company is now putting in a 100 light dynamo for the Baker Castor Oil Co. of Jersey City and doing all the wiring. A large winding room has been fitted up since the fire, with all the latest improvements, and the most expert winders of different makes of machines have been employed.

NEW ENGLAND NOTES.

THE BERLIN IRON BRIDGE Co., of East Berlin, Conn., are furnishing the iron roof for the new boiler and dynamo room for the Larchmont Electric Co., at Mamaroneck, N. Y.

SOUTHERN NOTES.

THE SOUTHERN ENGINEERING COMPANY (INC.) of Louisville, Ky., have decided to close out the electrical supply branch of their business, and in the future will confine their attention to the construction of steam and electric light and power plants, the manufacture of electrical specialties and electrical repair work. In order to close out their supply stock rapidly, they are disposing of their entire stock at cost. They have issued to the trade a price sheet, showing some rare bargains.

Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.

Vol. XVIII

SEPTEMBER 12, 1894.

No. 332.

SCHROON LAKE: THE SUMMER DIVERSIONS OF AN ELECTRICAL AMATEUR.

IT is not often that we encounter, at least in this country, the scientific amateur who combines with love for scientific investigations and pursuits the ability to turn these studies to practical account in embellishing the household and enhancing the comfort of his own home and that of his neighbors. Electricity, especially, affords such a fascinating field for the scientific amateur that it is strange that not more have entered it than seems to be the case. Among the notable devotees in this field we may mention Mr. Henry V. Parsell, of this city, who, together with his son, Mr. Henry V. Parsell, Jr., has for a number of years devoted time and attention largely to experiments and investigations, as well as to the practical application of electrical devices. It would be of interest to record their experience in the lighting of their home in this city by electricity, and the various methods and apparatus employed by them, beginning with the primary battery and

work thoroughly carried out in every detail, and in this case is all the more conspicuous as representing purely a labor of love, and a desire to enhance the pleasure and comfort of Mr. Parsell's fellow cottagers.

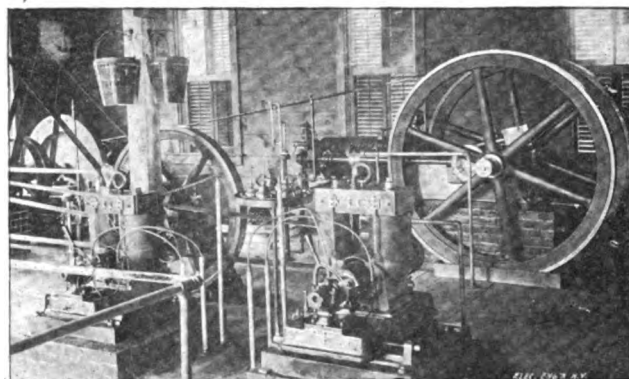


FIG. 2.—THE DYNAMO ROOM.

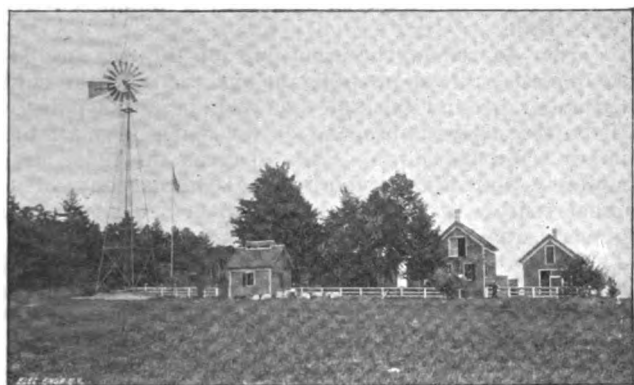


FIG. 1.—ELECTRIC LIGHT PLANT AND WORKSHOPS, TAYLOR'S-ON-SCHROON.

passing through various stages of storage battery, oil engines, gas engines and dynamos as these gradually became perfected; and we might also, if space permitted, dwell on results obtained in the domain of electrical timekeepers. But we will confine ourselves, for the present, to a description of what may well be called a model electric lighting plant and workshop, erected by Mr. Parsell, at Taylor's-on-Schroon, Warren Co., N. Y., at the portals of the Adirondacks.

Mr. Parsell's cottage forms one of 15, grouped around a hotel and connected by board walks aggregating nearly a mile in length, situated among the pines on a slight eminence overlooking the beautiful Schroon Lake. It was Mr. Parsell's original intention to light only his own cottage and to afford him current sufficient for experimental purposes, but the success of the first small plant was such that a large one was soon undertaken, so that at present there are over one hundred and thirty 16 c. p. lights in operation, lighting Mr. Parsell's house and laboratory, the hotel porch and a mile of board walk. The plant is worthy of description because it forms a bright example of a piece of

The electric light plant is situated about 1,000 feet back from the cottages and is made up of a collection of buildings, shown in the engraving Fig. 1, the largest of which is the engine and battery house, a wooden structure divided into two parts. The first of these contains the dynamos and engines, of which there are two each. Otto gasoline engines are employed, one of 16 H. P. running at 240 revolutions per minute and another of 4 H. P. running at 360 revolutions per minute. The larger engine drives a counter shaft at 760 revolutions which carries a 3' 9" solid disc fly wheel. The power is transmitted through Moore & White friction clutches, and belts to the dynamo direct. It also drives an overhead counter shaft which is belted to a Goulds triplex pump. The dynamos are, respectively, of

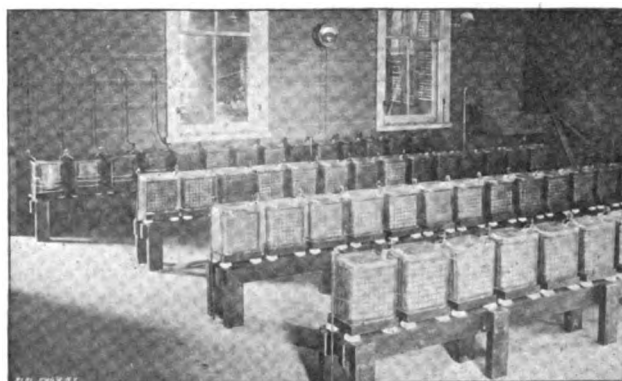


FIG. 3.—THE STORAGE BATTERY ROOM

3 and 5 kilowatt capacity, running at 100 volts; they are of the Edison bipolar type and the arrangement is shown in Fig. 2.

Although the engines are sufficient to furnish the cur-

rent required when all the lights are in operation, it was not deemed desirable to operate them all night; therefore a storage battery plant was installed, which occupies the remaining portion of the engine building, and which is shown in Fig. 3. The storage battery room forms an annex to the engine house and is of the same dimensions, 26 by 26. There are here installed 52 cells of the chloride type, made by the Electric Storage Battery Co., of 200 ampere hours capacity having a discharge rate of 20 amperes; to these are added 4 cells of the Accumulator Co., employed as counter E. M. F. for regulating the potential on the main. The wires coming from the engine room pass below the floor and are brought up through glass floor insulators at the ends of the racks.

The cells are mounted on racks 12 inches high and rest on porcelain insulators. A space of three feet is left between the racks which affords ample room for passing between cells and examining them from all sides. For

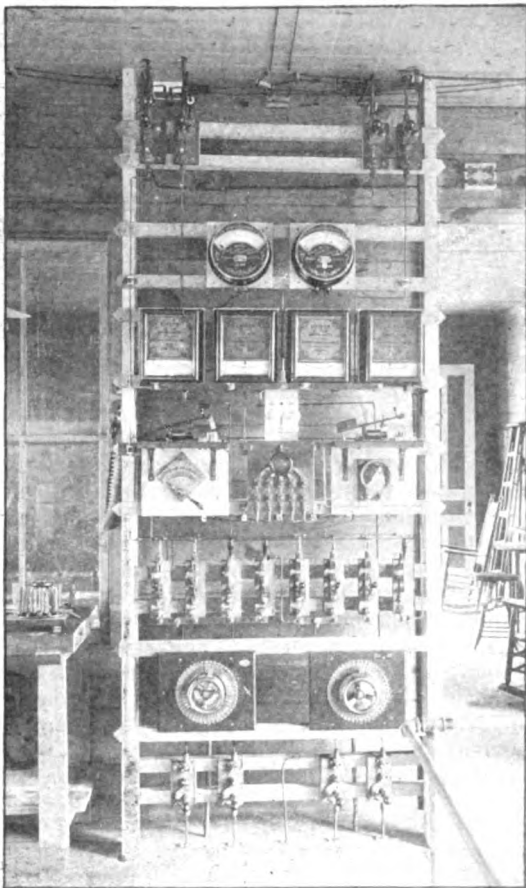


FIG. 4.—THE SWITCHBOARD.

connecting the mains to the batteries a special non-corrodible connection is made by first soldering a lead strip to the copper main. This is then covered with compound and taped and the lead strip then bolted to the battery lugs. For testing each individual cell, wires lead under the flooring and come up at each rack so that all cells can be conveniently read. A Weston voltmeter reading up to 3 volts is used for this purpose, the divisions of which read direct to $\frac{1}{10}$ volt and allow $\frac{1}{100}$ to be easily estimated. All who have handled storage batteries know how tedious is the work of setting up cells, owing to the long time required for mixing the acid and allowing it to cool. In order to obviate this annoyance Mr. Parsell has devised a mixing tank in which is placed a coil of pure lead pipe, through which cold water is constantly run during the mixing process.

The switchboard placed in the engine room at the

entrance to the battery room is shown in Fig. 4. The instruments and switches are mounted on an open frame set forward from the wall. The wires issuing from the terminals of the dynamos, as will be seen in Fig. 2, pass down through Interior Conduit tubing below the floor, and up again at the switchboard through glass insulators. At the lower rack they are directly connected to the dynamo fuses and plugs, above which are situated the field regulators. These are followed by eight main switches, six of these connect dynamos to the mains for charging the batteries in the station or in the electric launch, to be described later. Another is used for connecting the two dynamos together, and another for connecting the station batteries to the main. Situated above the switches is the battery cutout which guards against over discharge; in the centre there is a regulating cell switch and above, on either side, two magnetic cutouts on the charging circuit, which disconnect the batteries when the current falls below a certain limit, so as to guard against a back flow through the dynamo. Situated directly over the regulating cell switch is the ground detector, consisting of two lamps. Above that are four Edison ammeters and a Weston ammeter and voltmeter, which latter are used for the main line only; at the very top finally are the main line and launch charging fuses.

The wires are distributed at a point about 1,000 ft. from the station, running into a distributing switch board situated in the hotel. Pressure wires from the distributing pole run back to the station to a Howell two-lamp standard pressure indicator. Private cottages desiring current are fed by special wires from the main junction pole and pay for current by contract or by meter as preferred.

The Goulds triplex pump in the engine room supplies the hotel with water, and an automatic electric belt shifter operated from the tank shuts off the pump when the tank is full.

In order to render the usual puff of the gas engine as little objectionable as possible, the exhaust from the engine is led under ground through a 10-inch pipe to a point 150 ft. from the engine house, the outlet being a small brick chimney a few feet high. This deadens the noise almost completely and adds much to the complacency of the summer visitor. Over the engine room are situated the engineer's quarters and the store rooms.

The care bestowed upon the arrangement and equipment of the generating plant has also been extended beyond the confines of the engine room, and, indeed, is notably visible in the character of the pole lines which distribute the current through the grounds. The poles are painted in the four colors adopted by Mr. Parsell as his standard in all the structures at Schroon. Extending up 6 ft. from the ground they are painted green and then yellow up to the cross arm, above that point a dark red is employed, while the cross arm itself is white. The effect is very pleasing and the poles detract little, if any, from the beauty of the scene. The conductors are protected from the falling branches of trees by a barbed guard wire, which also acts in the capacity of a lightning guard, being connected at intervals of 200 ft. with the ground. The barbed wire seems to have been particularly efficacious; the line has been erected for nearly 5 years and although lightning and thunder storms are very severe in these parts the line was struck for the first time only a few weeks ago. It passed down the ground wire, taking a small chip off the pole, doing no further damage than the breakage of a few lamp filaments, blowing a few fuses, and the burning out of the resistances in the station voltmeters. The disturbances in the atmosphere must have been very great as the recording barometer showed a variation of over $\frac{1}{4}$ inch. Beside this protection against lightning there are two swinging ball lightning arresters on the pole adjoining the station.

The fuel employed in the gasoline engine is naphtha, the supply for immediate use being stored in a special house

situated about 150 feet from the engine house and consisting of two 100 gallon tanks buried in the ground. A Gould duplex naphtha pump supplies the engine, being worked by water pressure, which comes from the hotel tanks. After passing through the pump the water is led through the jacket of the engine cylinder. The surplus naphtha not used by the engines flows back to the tanks. The main storage supply of naphtha is situated some 2,000 feet from the engine room so that by making the temporary supply small the danger from fire is greatly reduced.

Adjoining the dynamo and battery house is the machine shop, covering an area of 18 by 22 and containing a lathe, a shaper, an emery grinder and bench tools and on the floor above a carpenter shop equipment; the whole being driven by a 5 H. P. Crocker-Wheeler motor. The collections of buildings at this point is completed by blacksmith and pipe shop.

As stated above, a part of the current is employed for charging the batteries in an electric launch, the "Falcon," which is shown in Fig. 5. This craft, built by the General Electric Launch Co., is 30 feet long and 6 feet beam, drawing 2 feet of water. It has an equipment of 60 Bradbury-Stone storage cells, having 150 ampere hours capacity, which enable it to run 8 hours at the normal speed of 6 miles an hour. The cells are grouped, and so connected to the controller so as to give 4 speeds, forward, and one reverse, but in the new controller which will be shortly installed it will be possible to attain 8 speeds ahead and 3 reverse.

The motor is a 4-pole machine set in a lead lined water tight box, with a water tight packed cover, the shaft passing toward the stern through a stuffing box; in this way the motor is kept entirely free from water. The thrust block has ball bearings, and the motor is ventilated by funnels placed fore and aft. A small hand regulating projector above the pilot renders landing in the dark safe and easy. It may be worthy of note that Mr. Parsell formerly owned and operated a naphtha launch on the Lake, but adopted the electric launch on account of its greater ease of control, and absence of annoyance due to the use of naphtha. In addition to the launch Mr. Parsell has just finished an electric dingy equipped with 13 Chloride cells and a $\frac{1}{2}$ h. p. Perret motor, Carpentier ammeter and a Crocker-Wheeler reversing regulator.

When evening approaches and the Lake itself does not tempt, opportunity for pastime is afforded by an electric search light, situated in a tower 150 ft. above the level of the lake. The lamp is of the 2,000 c. p. Ward focusing

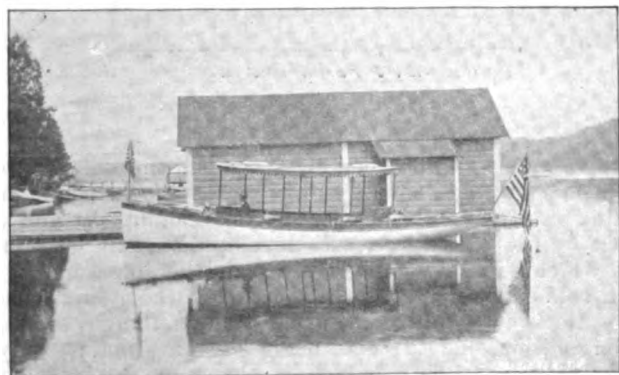


FIG. 5.—THE ELECTRIC LAUNCH "FALCON."

type, built by the Electric Construction & Supply Co. The lamp can be manipulated from a platform, situated below, the use of which will be appreciated by those who are not particularly fond of the society of myriads of insects, which are attracted by the brilliant beam of light. The tower, we may add, is also used for weather observations, being provided with a signal service weather vane and other meteorological apparatus.

The water supply of the hotel and cottages given by the triplex pump is assisted by a wind-mill operating a 12-inch geared pump. This windmill, built by the Aero-motor Co., of Chicago, is placed on a tower 50 ft. high. The office, laboratory, engine room and boat house are connected by telephones on the Colvin interior system.

The laboratory is situated in a separate two-story structure, one of the rooms of which is shown in Fig. 6. This

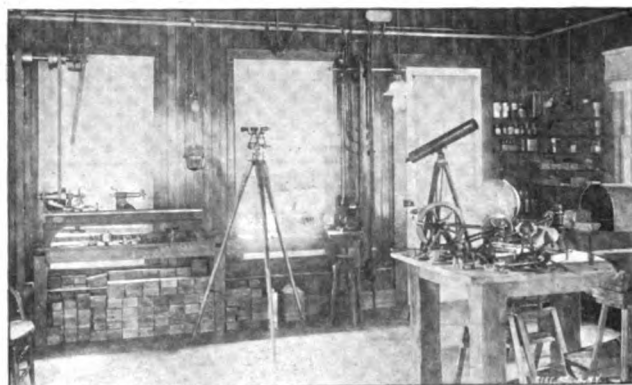


FIG. 6.—THE LABORATORY.

is equipped with a variety of electrical testing apparatus, including d'Arsonval galvanometer, Nippoldt telephone bridge; and to these are added microscopes, sextant, telescope transit and level, standard barometer, etc. For experimental work a Reed bench lathe is provided, driven by a $\frac{1}{2}$ H. P. Edison slow-speed motor. The equipment also includes portable forge and plate store, an electric heater, and also a rain gauge. The wiring throughout the laboratory is run in interior conduit brass-covered tubes.

The basement is occupied by a photographic laboratory and dark room. The latter is electrically ventilated, so that work may be carried on in it for extended periods without discomfort.

From the above necessarily brief description it will be evident that Mr. Parsell has exercised great intelligence in the equipment of his electrical plant, in which everything has been done with the main view to securing comfort and pleasure, yet the question of utility has never been lost sight of and the plant has been installed in the most substantial manner. This is evident by the report made on it by the insurance inspector, who could suggest a change in but one or two slight details. All the work of installation has been carried out under the supervision of Mr. Henry V. Parsell, Jr., whose electrical work in various directions has become familiar to the New York public, and it reflects credit both on him and upon Mr. Parsell, Sr., whose progressive spirit has called the plant into existence.

THE LÄNDERBANK, of Vienna, Austria has acquired the patents for the manufacture of Mr. E. G. Acheson's carborundum for the whole of Europe, with the exception of England, Germany, Denmark, Norway and Sweden. After having equipped a trial plant of 250 H. P., the result proved so satisfactory that two large factories will shortly be erected, one in Austria and one in France. We understand that the Carborundum Company, of Pittsburg, has now under consideration the removal of its factory to Niagara, where ultimately several thousand H. P. may be employed in the manufacture of carborundum.

A SPECIAL dispatch from New Orleans of Aug. 28 says: One of the big driving wheels in the works of the Louisiana Electric Light Company burst this morning. Only one man was injured—Superintendent McGrath, who had charge of the plant.

THE DUNCAN ALTERNATING CURRENT METER.

BY WM. S. RESOR, B. S.

IN the early days of electric lighting it was customary to charge so much per lamp per week, month or year, because there were no practical recording meters. This was, of course, most unsatisfactory both to supply companies and to consumers. A recording meter was the dream of both. It was not long before various types of recording meters appeared, which recorded, it is true, but which had certain defects; thus the majority of them made the electric light very cheap for the small consumers, and very expensive for the large ones, on account of the slow speed

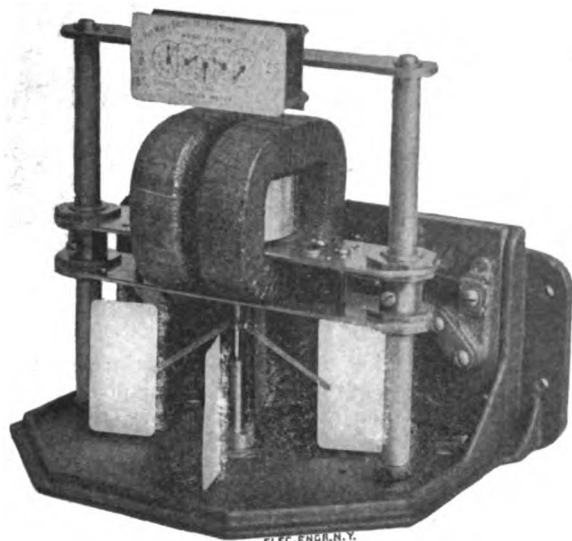


FIG. 1.—DUNCAN ALTERNATING CURRENT METER.

on a small number of lights, and the high speed on a large number.

It was with the object of overcoming this difficulty and to obtain a meter which recorded correctly at *all* loads, that Mr. Thomas Duncan, of the Fort Wayne Electric Corporation, designed the one illustrated in the accompanying engraving, Fig. 1.

This meter, depends on the principle of the repulsion of a closed secondary from its primary, and is a thoroughly practical and efficient development of Prof. Elihu Thomson's classical experiments on that principle.

The essential parts of the meter are the primary or field coils a , a' Fig. 2, which are connected in series with the

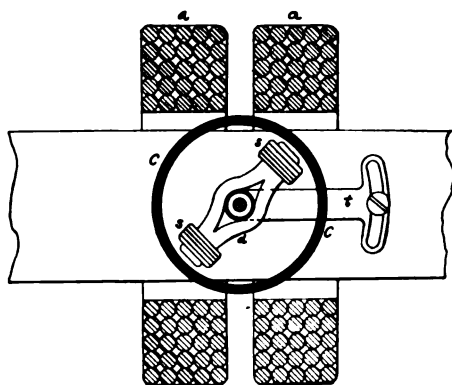


FIG. 2.

lamp circuit, the secondary or armature c consisting of an aluminum cylinder, a magnetic path diverter d , made of laminated iron, and carrying a closed secondary s which consists of a number of copper punchings; the aluminum

fans, the registering train, and the spindle which carries the armature and fans.

A very important feature of this meter is, that there are no brushes or commutator or other contacts. The

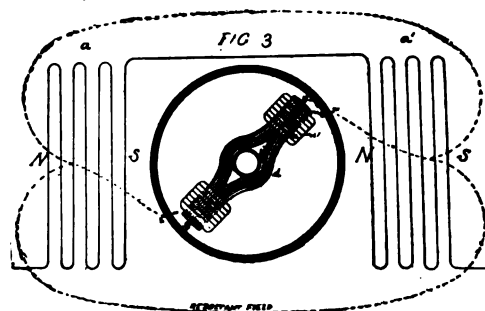


FIG. 3.

armature has no electrical connection with the circuit, the motion of the armature or cylinder being due to the repulsion set up against it as a closed secondary, from the primary or field coils a and a' .

This action may be explained as follows:—When the lamps are turned on, the current flows through the coils a and a' , and an alternating field is set up. This field is distorted or diverted from its natural direction, along the axis of a and a' , by the diverter d , and assumes a form similar to that shown in Fig. 3. Foucault currents are generated in the armature and also in the closed secondary on the diverter. The use of this secondary on the diverter is to reverse its polarity.

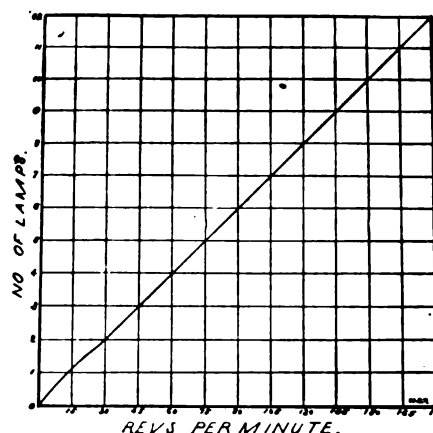


FIG. 4.

Suppose we consider the instant when the polarity of the primary or field coils a and a' are as shown in Fig. 3; the flux as it cuts through the cylinder obliquely, and as shown by the dotted line, will develop Foucault currents in it, which will have poles as shown in the diagram, i.e., a south pole on the outside circumference of the cylinder and facing the south pole s of the primary coil a , thereby setting up a repulsion, due to their being of the same polarity. Again the north pole n which is shown on the inner circumference of the cylinder will be attracted by the south pole s of the diverter d . Therefore, the rotation is due to the repulsion set up by the two south poles on the outside of the cylinder, and the attraction between the two unlike poles inside. The same condition exists on the other, or right hand, side of the cylinder, only differing in sign of polarity.

The closed secondary which is divided into two, each half being placed upon the respective poles of the diverter d , is for the purpose of changing the original or induced polarity of the diverter, so as to obtain a maximum torque

in effecting an attraction between the induced poles on the inner surface of the cylinder and the diverter.

If the axis of the diverter be placed along the axis of the coils a and a' , or at right angles to it, there will be no motion, all the energy being expended in producing a lateral pressure on the shaft; but as soon as it is moved from either of these positions, the

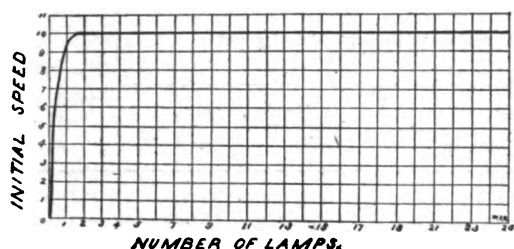


Fig. 5

force acts along a line which does not pass through the vertical axis; hence we have motion whose speed depends on the size of the angle formed by the two axes. Forty-five degrees gives the greatest speed.

The meter has a speed curve which is a straight line. The following table contains the results of a test on a 12-light Duncan meter:

No. of lamps.	Rev. min.	Initial speed.	Per cent. error.
1	14	14	-6.6
2	80	15	0
3	45	15	0
4	60	15	0
5	75	15	0
6	90	15	0
7	105	15	0
8	120	15	0
9	135	15	0
10	150	15	0
11	165	15	0
12	180	15	0
13	195	15	0
14	210	15	0
15	225	15	0

The speed on one light is a few per cent. slow, on some as low as two per cent., but on all other loads the meter is correct. Fig. 4 shows the speed curve plotted from the above table.

Fig. 5 is an initial speed curve for a twenty-five light meter, and shows the remarkable constancy which the

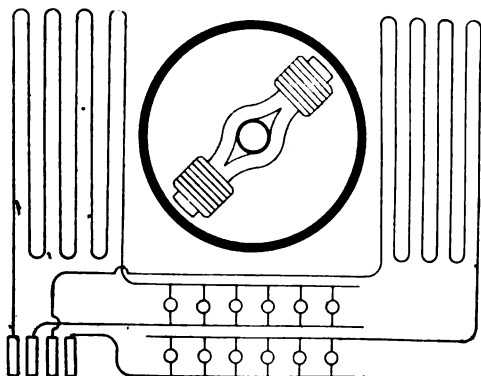


Fig. 6.

meter maintains throughout its entire range. Mr. Duncan has also applied this principle to meters for measuring and recording multiphase currents, and with particular success in the cases of two and three-phase currents; and also as a wattmeter for measuring the total energy. Fig 6 shows a

two-phase meter, and Fig. 7 a three-phase. A striking peculiarity of the multiphase current meter is that it can

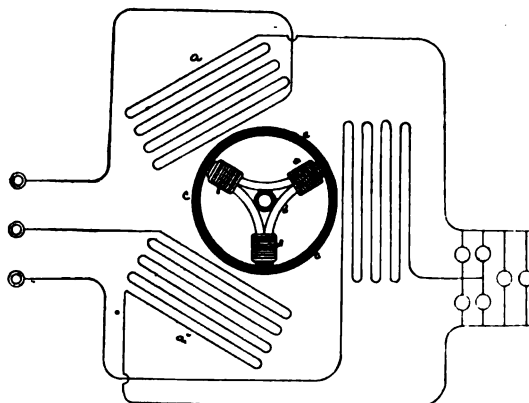


Fig. 7.

be operated with single-phase current, by simply connecting its field coils in series or multiple arc, and in series with the lamps.

MAGNETIC LEAKAGE IN DYNAMO-ELECTRIC MACHINERY.—III.

BY

Alfred E. Wiener.

IN order, now, to comply with the above condition, viz., $k > 0$, in this equation the term in the parenthesis must be positive, $(1 - P \times n) > 0$, and this is the case only if $P \times n < 1$. For the ratio $n = 1$, for instance, the permeance must therefore be $P < 1$; Prof. Thompson, however in the third column¹ of his table, gives a value of P , greater than unity, viz., 1.497, for this ratio. The mean length of the permeance path in his formula, consequently, is assumed smaller than the least distance apart of the cylinders; his formula, therefore, in spite of its complexity, does not express facts in accordance with the fundamental law of magnetic leakage.

(f.) *Two parallel cylinder-halves.*

If two cylinder halves face each other with their curved surfaces, Fig. 7, the mean length of the magnetic path is $c + .3 d$, where c is the least distance apart of the curved surfaces, and d the diameter of the cylinders, and we have for the permeance:

$$P = \frac{d \times \frac{\pi}{2} \times l}{c + .3 d} = \frac{d \times \pi \times l}{2 c + .6 d} \dots \dots \dots (12)$$

The mean length of the path is geometrically found from Fig. 8, as follows:

$$2 z^2 = \left(\frac{d}{2}\right)^2; \quad z = \frac{d}{2} \sqrt{\frac{1}{2}}$$

$$\therefore y = \frac{d}{2} - z = \frac{d}{2} \left(1 - \sqrt{\frac{1}{2}}\right) = .15 d$$

$$x = c + 2 y = c + .3 d.$$

1. Thompson, in his table, has taken as unity the permeance of 1 cm.² of air in absolute units of M. M. F., making the permeance of 1 cubic inch of air, in practical units of M. M. F., $= 2.54 \times \frac{4 \pi}{10} = 3.192$. In the present article, however, for convenience the permeance of 1 cubic inch of air is chosen as unity, and therefore, for comparison, the values in column 3 are to be considered.

For, in this case, the extent of the leakage field is much smaller than in that of full cylinders, and the mean path can be assumed a straight line meeting the two semicircles at an angle of 45° from the centre line.

C. Relative Permeances in Dynamo-Electric Machines.

(a.) General Principle.

In taking the magnetic potential between two polepieces of opposite polarity as unity for calculating the relative permeances in dynamo-electric machines, the potentials between various points of the magnetic circuit depend upon the number of magnet-cores, magnetically in series between two consecutive poles of opposite polarity. If, as is the case in the majority of types, there are two magnets between any north-pole and the next south-pole of the machine, then the magnetic potential between two points of the magnetic circuit separated by but one magnet, is $= \frac{1}{2}$; and two points not separated by a magnet-core, have no difference of magnetic potential, their potential $= 0$. If the circuit consists of but one magnet, or of several magnets magnetically in parallel, then the magnetic potential between any two leakage surfaces of opposite polarity is $= 1$, i. e. the difference of magnetic potential between the polepieces.

The observance of this general principle enables us to bring all the relative permeances into proper relation

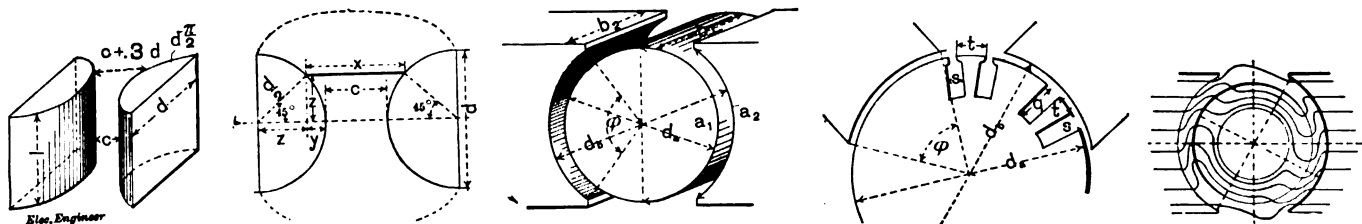
The amount of this deflection naturally depends upon the speed of the revolving armature and upon the density of the lines, and is proportional to the product of these two quantities.

Averaging from a great number of dynamos under various conditions, the writer has found the following values of k_1 :

TABLE II. FACTOR OF FIELD DEFLECTION.

Product of Conductor Velocity and Field Density.		Factor of Field Deflection. k_1 .
English measure. Velocity in feet per sec. Density in lines per sq. in.	Metric measure. Velocity in meter per sec. Density in lines per cm ² .	
Below 400,000	Below 20,000	1.10
400,000 to 600,000	20,000 to 30,000	1.15
600,000 " 800,000	30,000 " 40,000	1.20
800,000 " 1,250,000	40,000 " 60,000	1.25
1,250,000 " 2,000,000	60,000 " 100,000	1.30
Over 2,000,000	Over 100,000	1.40

In *toothed* armatures the magnetic lines partly enter the teeth, and partly pass to the bottoms of the slots, the mean length of their path, therefore, is the geometrical mean of



FIGS. 7, 8 9, 10 AND 11.

to each other, and we can now apply formulæ (7) to (12) to the cases of a dynamo.

(b.) Relative Permeance of the Air Gaps. (P_1).

The mean area of the gap space for any armature facing poles opposite its outer periphery is given by the equation:

$$A_g = \frac{1}{2} (a_1 + a_2) \times \frac{1}{2} (b_1 + b_2), \dots \dots \dots (13)$$

where A_g = area of gap-spaces, in square inches;

a_1 = half perimeter of armature-core, in inches;

for *smooth* cores, Fig. 9: $a_1 = \frac{d_a \times \pi}{2} \dots \dots \dots (14)$

for *toothed* cores, Fig. 10: $a_1 = \frac{d_a \times \pi}{2} + n \times q \dots \dots \dots (15)$

d_a = diameter of armature core, in inches;

n = number of teeth;

q = depth of slots, in inches;

a_2 = circumference of half the pole-pieces, in inches;

$a_2 = d_b \times \pi \times \frac{p \times \varphi}{360^\circ} \dots \dots \dots (16)$

d_b = diameter of base of pole-pieces, in inches;

p = number of pairs of magnet poles;

φ = angle embraced by each pole;

b_1 = length of armature-core in inches;

b_2 = length of pole-pieces, in inches.

The mean length of the path, in both gaps, for *smooth* armature cores is:

$$l_g = k_1 \times (d_b - d_a), \dots \dots \dots (17)$$

where k_1 is a constant depending upon the degree of deflection of the lines of force, see Table II. It is well known that in a dynamo-electric machine, when the armature is in motion, the magnetic lines do not cross the air gaps at right angles, but are deflected into an oblique position, Fig. 11, owing to the shifting of the neutral line.

the distances of teeth and slots, respectively, from the polepieces:

$$\begin{aligned} l_g &= \frac{s \times [k_1 (d_b - d_a) + q] + t \times k_1 (d_b - d_a)}{s + t} \\ &= \frac{k_1 \times (s + t) (d_b - d_a) + s \times q}{s + t} \\ &= k_1 \times (d_b - d_a) + \frac{s \times q}{s + t} \dots \dots \dots (18) \end{aligned}$$

s = width of slots, in inches;

t = width at top of teeth, in inches;

d_a = diameter of armature-core, in inches; } Fig. (10)

d_b = diameter of base of field, in inches; }

q = depth of slots, in inches.

Combining formulæ (13), (14), (16) and (17), and formulæ (13), (15), (16) and (18), respectively, the relative permeance of the air gap, for smooth and for toothed armatures, respectively, is obtained.

For *smooth* armatures we have:

$$\begin{aligned} P_1 &= \frac{A_g}{l_g} = \frac{\frac{1}{2} \left(\frac{d_a \pi}{2} + d_b \pi \times \frac{p \times \varphi}{360^\circ} \right) \times \frac{1}{2} (b_1 + b_2)}{k_1 \times (d_b - d_a)} \\ &= \frac{\frac{1}{8} (d_a \pi + d_b \pi \times \frac{p \times \varphi}{180^\circ}) \times (b_1 + b_2)}{k_1 \times (d_b - d_a)} \dots \dots \dots (19) \end{aligned}$$

and for *toothed* armatures:

$$P_1 = \frac{A_g}{l_g} = \frac{\frac{1}{2} \left[\left(\frac{d_a \pi}{2} + n \times q \right) + d_b \pi \times \frac{p \times \varphi}{360^\circ} \right] \times \frac{1}{2} (b_1 + b_2)}{k_1 \times (d_b - d_a) \times \frac{s \times q}{s + t}}$$

$$= \frac{\frac{1}{8} \left(d_i \pi + d_o \pi \times \frac{p \times \varphi}{180} + n \times q \right) (b_i + b_o)}{k_i \times (d_o - d_i) \times \frac{s+q}{s+t}} \dots (20)$$

These formulae, although they look somewhat complicated, are in fact very simple, since dimensions which, in a practical example, can be directly taken from the drawing, have here to be algebraically expressed by the given quantities.

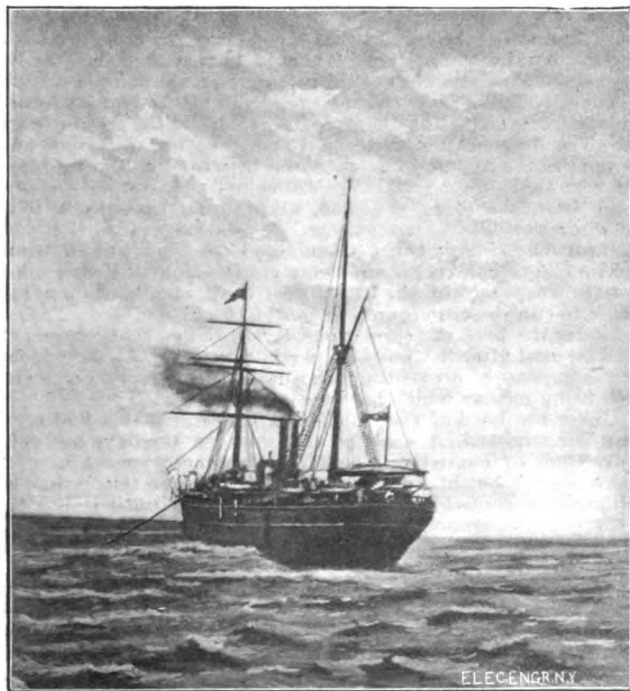
For armatures revolving outside of a magnetic field, innerpole type, in the denominator of formula (19) the order of the diameters d_i and d_o is to be reversed, as in this case, d_i , the internal diameter of the armature-core, is larger than the diameter of the field.

If poles are situated interior as well as exterior to the armature, the mean of the outer and inner gap-areas has to be taken, in applying formula (13) to the inner diameter as well as to the outer diameter of the core; and instead of $(d_o - d_i)$ the sum of the outer and inner gaps is to be substituted.

In case of armatures, finally, facing the poles in the axial direction, flat ring type, the gap-area, if polepieces are used, is the mean of half the pole-area and the ring area of the armature core; and if no separate polepieces are employed, is practically equal to half the sectional area of the magnet cores. The mean length of the path is the difference between the axial pole-distance and the axial breadth of the armature-core, multiplied by the factor of field-deflection.

THE COMMERCIAL "ALL-SUBMARINE" CABLE FROM NEW YORK CITY TO EUROPE.

The various troubles incident to the maintenance of shore line connections between New York and the Nova Scotian coasts, made the Commercial Cable Co. resolve to bring their new cable direct by sea into New York City; and the feat was accomplished on Sunday, September 2. Among the troubles rendering this plan

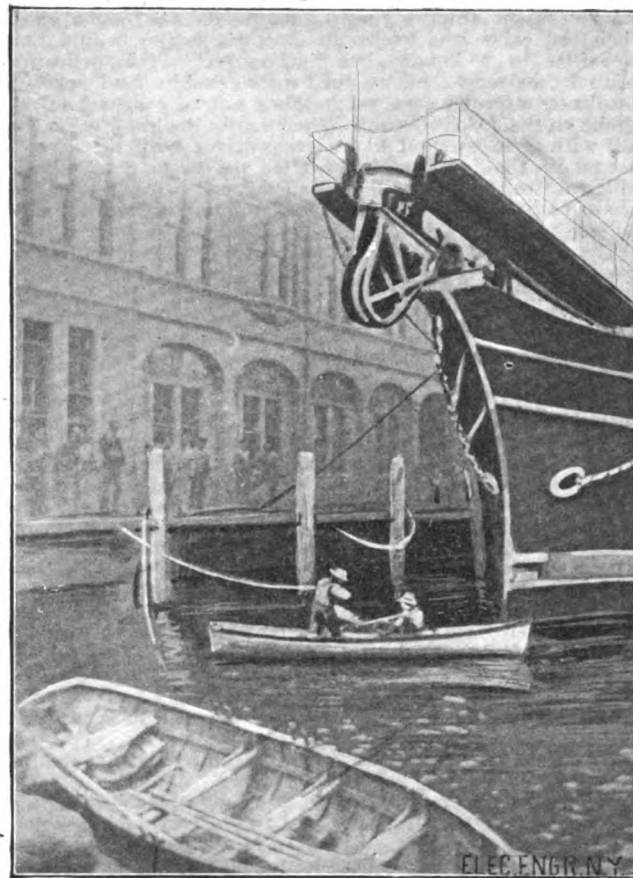


LAYING THE LAST SECTION OF THE "ALL SUBMARINE" CABLE.

preferable, despite the dangers that lurk for a cable on the floor of busy New York Bay, are the breakage of land lines in storms, the difficulties of winter repairs, the destruction of cables in long subways by gases, and more lately the interruption and distortion of signals by the current from trolley lines in Brooklyn, which

parallel the old Commercial Cables from their landing at Coney Island up to Brooklyn Bridge.

At noon on Sunday, Sept. 2nd, the laying of the Commercial All-Submarine Cable to New York City from Europe was completed and the sight of the trim cable ship "Mackay-



LANDING THE CABLE AT NEW YORK CITY.

Bennett" actually at work in New York harbor created quite a sensation if one can judge from the noisy salutations she received from all manner of craft as she slowly but carefully continued her work up to the Battery. There is no necessity to describe the apparatus on board the "Mackay-Bennett" as nearly every one connected with electrical industries is now generally familiar with it. One little thing your representative saw which may not have been noticed by some people was the Thomson sounding tubes. These tubes are of glass two feet long by about one-eighth inch outside diameter. They are orange colored on the inside with some secret pigment and one end is sealed. This tube is inserted in a metal case secured open end downward. The ordinary sounding drum is all right for say 200 fathoms but as the wire runs off the diameters get shorter and the revolutions do not register accurately; with this tube it is simply a matter of density of the water. The lower the tube drops, the higher the water is forced up it, compressing the air and discolored the orange tint to a dark grey. Upon recovery, the height of the discoloration is measured on an ordinary foot rule and the depth worked out from a corresponding coefficient. These coefficients are placed alongside the rule for convenience, so the depth is ascertained at once. In running out the sinker the officer has his right hand on the brake of the drum and in his left holds a skid with which he puts a slight tension on the running wire; by the sense of touch he is able to tell at once when the sinker strikes bottom. By this means it is possible to sound to 3,000 fathoms in about 15 minutes—a slight difference from the 1½ hours to 2 hours in the old days, not counting the distance the ship had drifted in that time.

The operations were commenced Thursday by marking out the course from the Coney Island cable hut to a position about ¼ mile off Norton's Point with buoys. On Friday this was finished and the coiling on board the tug "Stranahan" of the 4 mile piece to be laid from the hut to this position was also completed. On Saturday this piece was laid, the end buoyed and thrown overboard. Mr. Charles Cuttriss superintended the shore work while Capt. Schenk of course conducted the sea part of the business. On Sunday the final work was started at 6 a. m., the ship came

up with and took aboard the buoy with the end of the cable, this was spliced to a piece in the main tank of the ship, 12 knots long, by Joiner Sage. The cable,—2 inches in diameter, composed of 4 cores solid No. 16 B. W. G. conductors, Siemens gutta percha insulation, covered with jute, surrounded by 23 No. 18 galvanized iron wire over which laid in opposite direction were 12 No. 0 galvanized iron, finally served with tarred serving,—was laid bare to the core for about 20 feet at each end (piece on shore and pieces on ship). The joiner made the joints so that when the cable was relaid up as a whole they would not be altogether in a bunch, but "staggered." This delicate job requires extreme nicety of workmanship and particular cleanliness, especial care being taken not to overheat the sheet percha on the "G. P." core. When finally the last layer is tooled over with an instrument like a screwdriver with the sharp end ground off, the jute is replaced, after the gutta percha has had sufficient time to harden, and each layer of wire is relaid back into its place and the whole lashed round with marlin, making the splice about 50 feet long.

The gentlemen who had received invitations were taken on board by tug at the Marine and Field Club, Bath Beach, at 7:45 A. M., and came alongside the cable ship 20 minutes later, while the nimble-handed sailors were lashing the last layers with their serving mallets. While these final preparations were being completed, the guests were requested to sit down to a very substantial breakfast.

After breakfast your representative went with the electrician, Mr. C. Priest, to the testing room. Mr. Priest is to be congratulated upon having the most comfortable and commodious ship's testing room we have ever seen, and we have seen a good many. It comprises two marine galvanometers, one being connected with a Siemens copper resistance testing set; a complete set of dial resistances fixed to the wall at the side, standard 100,000 ohms attached in the same way, one large cable terminal in the centre of the table and a row of smaller in front, battery, discharge, short circuit keys, condensers, reversers and commutators, all right under the hand of the operator. Adjacent stand a mirror speaking instrument, lamps and transparent scales, etc. The mirror speaking instrument, although a relic of the past as far as actual commercial work is concerned is used almost entirely on board cable ships. The mirror is attached to a small fibre which is held taut by a flat spring fixed along the side of a tube whose internal diameter is slightly larger than the mirror. This tube is filled with kerosene and thus the movement is rendered quite dead beat.

Everything being all ready to go ahead, the cable being paid out over the picking up gear and bow sheave which is generally used only for picking up,—at 9:07 a. m. the engines were started and the ship backed slowly astern. A hose was played against the brake of the drum to keep it from heating and occasionally directed against the drum itself where the cable revolved around four times before going under the dynamometer sheave and thence to the forward sheave into the sea. When the ship was about due southwest of Norton's Point orders were given to turn her. When this was completed the cable was of course under her; this way she proceeded right up to Pier A. The object was to be able to bring the cable up to its final landing place at the Police Pier, more handily. The captain from the bridge with a chart before him directed the ship up the main channel which is the deepest water, with the first officer at the bow and the second at the steering gear. The signal to other ships to keep out of our way was hoisted from the foremast—a white cube with a red ball at either end. The indicator while paying out started at 10 revolutions in 55 seconds (330 revolutions = 1 knot) which meant $2\frac{1}{4}$ miles per hour, but when she settled down to it a few minutes later, the indicator read 10 revolutions in 25 seconds, 5 miles per hour or in cable laying parlance, 4.33 knots.

We came up off the Battery at 11:35 a. m. Mr. Priest gave orders to the joiner to put on cores 1 and 3, and he then put the speaking galvanometer in circuit, and your representative, who is an old submarine cable man, sent the first message, the current of course going along the cores to Coney Island and back again to the ship. Some delay was experienced in getting into the dock, as the Police boat "Patrol" was occupying it, and showed no disposition to turn out. After considerable delay she did so and the end was finally taken ashore exactly at noon.

The end has since been spliced on to the land piece which runs straight up from Pier A to Bowling Green, across Whitehall, along Stone street and thence up to the Commercial Co.'s office along Broad street, part being in the subways of the Consolidated Tel. & Elec. Subway Co. and part in the Commercial's own ducts. A large crowd watched these final operations from the dock at the Battery and comments and opinions were rife, while one "Fort Warder" advanced the information, that she was "A 'lectric whaler wid er derrick fur hūstin' der whales."

E. W. S.

VILLAGE TELEPHONE SYSTEM FOR CINCINNATI.

Captain George N. Stone, General Manager of the Cincinnati and Suburban Telephone Company, will be ready in a very short time to offer telephone service to village subscribers at very low rates of rental. He has just perfected a system by which ten or

more subscribers can be placed in telephonic communication. Captain Stone believes that his system will give entire satisfaction and supply a want that has long been felt by people residing in villages around Cincinnati. The new scheme will also embrace trunk line connection with Cincinnati and all other cities connected by telephone. The plan of operation of the improved suburban service has not yet been made public.

"ELECTRICAL EXPERTS."

BY CARL KAMMEYER.

Not long ago, a gentleman well known in electrical circles stated that probably not one electric light plant in twenty was paying expenses to-day, and his long experience in matters electrical would seem to be a guarantee that he knew what he was talking about. In making the statement he said that he referred particularly to the smaller plants in country towns, and gave as the principal reason that the majority of such plants were not properly designed or constructed to begin with. That there is considerable truth in his remarks is shown by a set of specifications recently prepared by the Consulting Engineer (?) of a small country town in Iowa, and it is for the purpose of remedying this evil that some of the extracts from the specifications are referred to, with a few explanatory remarks.

The specifications say that "In general, the plant will consist of one 60 h. p. automatic high speed engine, two 15 k. w. incandescent dynamos, thirteen 2,000 c. p. arc lamps, switch board and fixtures, 14,500 ft. three-wire circuit, foundation for engine and dynamos and wiring for private individuals." The engine is "to use 80 pounds of steam, exhaust to be arranged so it can be carried to a suitable heater." We presume that an engine using steam at a pressure of 85, 90, or 100 pounds would be excluded and pronounced as not coming up to the specifications.

Under the head of circuits, the specifications call for thirteen 2,000 c. p. arc lamps, each connected with a proper cut-out switch suitably arranged upon pole, so they can be turned on or off at will. This is evidently a new departure in electric light construction, although we do not exactly see the object of placing the cut-out switches upon poles unless it is intended to give the line man additional exercise by making him climb the pole whenever it is desired to switch a lamp on or off. The specifications further say that "lamps shall be 30 feet high

line poles not to be less than 25 feet high." What in the world the village will do with lamps 30 feet high is beyond our comprehension. "The cross arms must be of oak, Norway or yellow pine, straight, and to have two good coats of paint." The manufacturers of crooked cross-arms will please notice that their products would not be accepted. It is of course an oversight on the part of the "consulting engineer" in omitting to specify that the color of the cross arms must be red. At the same time he should have stated that the field magnets of the dynamos should be painted a similar color.

The specifications further call for "circuits to be wired on the three wire system, for 200 amperes, to be 14,580 feet in length, etc. The drop shall not exceed 11 per cent in the feeders and 4 per cent in the mains. The potential between positive and negative wire shall not be less than 220 volts." No drop of potential in the branches being specified, we presume that that is left to the discretion of the contractor. It is also specified that "the engineer may change route of uncompleted circuit at any time." The fortunate contractor who may get this job will have a hard time to keep within the 14,580 feet limit, should the engineer decide to run the circuit around the block.

Under the head of foundations, it is specified that "no mortar must be used after it wholly or partially sets." This is evidently for the purpose of preventing unscrupulous contractors or masons from using mortar which has been used before.

Under the head of special clauses, it is stated that "after the plant is completed, it shall be subject to a ten days test of ten hours each to insure the proper and satisfactory working of the entire plant," but in the same breath, it is stated that "the plant will not be accepted by the Board of Aldermen until it has been in successful operation for a period of 90 days," and that "the contractor will not be paid in full until the end of that time." It seems to us that if the plant has stood a satisfactory test of ten days, it might as well be accepted. We understand that after the specifications were printed, the city decided to modify them so as to call for one 30 k. w. alternating dynamo and 13 alternating arc lamps, and that the "consulting engineer" in the additional specifications required that the alternator should not spark at the commutator.

It is undoubtedly due to specifications like the above that reputable electrical contractors very often do not take the trouble to bid upon them at all, with the result that the plant is erected by incompetent and inexperienced workmen. If afterwards the results are not satisfactory to the stockholders, it is not at all surprising. It seems to us that when there are so many competent electrical engineers whose services can be had for a moderate compensation, no city or town can afford to have specifications prepared by so-called "engineers" whose principal qualifications seem to be a "pull" with the board of aldermen.

ELECTRIC TRANSPORTATION DEPARTMENT.

THE LA ROCHE ELECTRIC LAUNCH.

THERE is now in operation on the Schuylkill River, at Fairmount Park, Philadelphia, an interesting electric launch, built by Mr. F. A. La Roche, of that city. It measures 16 feet on the water line, 8 feet 10 inches beam, and draws about $1\frac{1}{4}$ feet of water. The principal feature of this launch is the arrangement of the

weighing 25 pounds, making the entire weight of all six encased in two wooden boxes which may be set in in any convenient part of the boat, only 175 pounds. The floor space occupied by the boxes is exactly 8 square feet. Current is conveyed to the motor through the rheostat and a reversing switch by an ingenious arrangement of the brass railing on the gunwale.

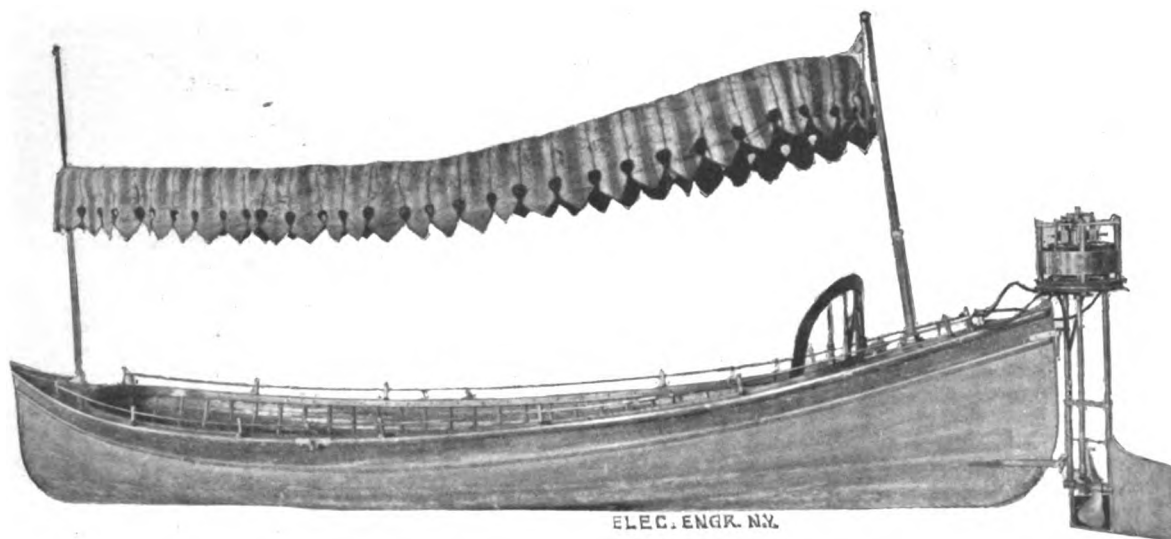
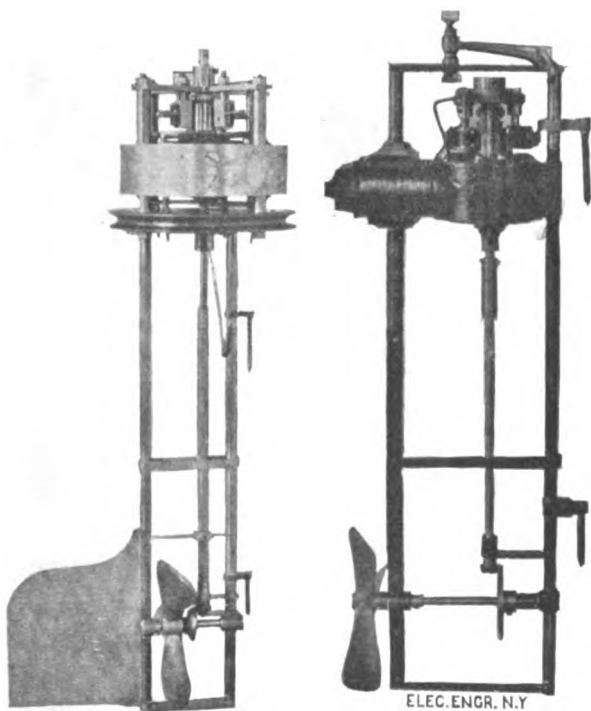


FIG. 1.—THE LA ROCHE ELECTRIC LAUNCH IN THE SCHUYLKILL RIVER, FAIRMOUNT PARK, PHILADELPHIA.

motor and shaft, as shown in the accompanying illustrations. It will be seen from Fig. 1 that the entire mechanism is set on the stern post in exactly the same manner as a rudder is hung on an ordinary boat or launch and may be removed at pleasure and set

Figs. 2 and 3 show two types of motor and their mechanism. The latter is a small $\frac{1}{2}$ H. P. machine capable of developing in the launch described, and with six cells of battery, a speed of four miles an hour, while the former is rated at $\frac{1}{2}$ H. P., but will give nearly double that amount for a short time if desired. All parts are made of aluminum and the motor is of the multipolar type running at 400 revolutions per minute and can drive the 16 foot launch at the rate of 8 miles per hour. In practice the motor is covered with a water-tight sheet iron cap.

This type of apparatus should become popular at summer resorts, etc., where boats are rented to the public, as any row boat can be turned into an electric launch, it is claimed, in an hour without in any way altering the boat itself. The first trial of the experimental launch was made at Fairmount Park last June with a small multipolar motor requiring 10 amperes and 12 volts and capable of developing $\frac{1}{2}$ H. P., when a speed that touched eight miles an hour was noted and a high rate was held until the batteries were exhausted. Some days later a speed of 10 miles an hour was gained with a smaller bipolar motor.



FIGS. 2 AND 3.—LA ROCHE ELECTRIC LAUNCH MOTORS.

on any other boat without alteration, provided, of course, that the rudder hinges are the same distance apart on both.

The accumulators, six in number, are of the La Roche type, each having twelve plates 6 x 6 inches and each cell

EXTENDING THE TROLLEY IN BROOKLYN.

It is announced that the directors of the Long Island Traction Company have decided to issue collateral trust notes paying six per cent. interest and having a face value of \$3,000,000. It is alleged that a syndicate has already signified its intention to purchase \$1,875,000 of the issue at 80. Traction stockholders will be permitted to purchase at 85. The company controls the entire Brooklyn City Railroad system. It is claimed that the new loan will be well secured.

The money is needed to extend the lines. There are between eighty and ninety miles of extension at the company's disposal, and work will be started soon. The Traction Company has authority to make its system half as large again as it is.

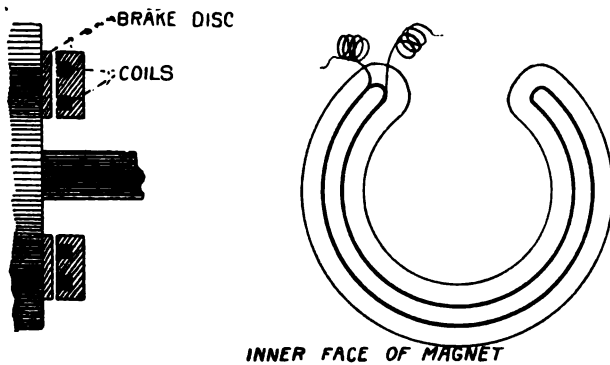
NEW HEILMANN ELECTRIC LOCOMOTIVES.

It is stated that the Compagnie des Chemins de Fer de l'Ouest, as a result of the experiments made with the Heilmann locomotive, have just ordered two new locomotives from the Société de Traction Electrique, who, it will be remembered, work the Heilmann patents. Certain improvements and modifications suggested by the trials of the original engine will be embodied in the new locomotives with a view to the construction of a definite type. The steam-engine chosen as best fulfilling the working conditions is

the Willans. It is further stated that Messrs. Willans and Robinson, through their French agent, M. A. H. Crozier, have been commissioned to deliver by January or February next two steam-engines, each of 1,500 h. p. It is intended to conduct experiments with the new locomotives in May, 1895, and if the results are conclusive it is reported that the Heilmann locomotive will be definitely adopted.

THE SPERRY ELECTRIC BRAKE.

Mr. E. A. Sperry, of the Sperry Electric Railway Company, Cleveland, has so far perfected his electric brake that it may now be said to have entered the commercial stage. The Twenty-third



FIGS. 1 AND 2.—THE SPERRY ELECTRIC BRAKE.

street electric line, of Chicago, has just equipped one of its cars with the device, and has found it in every way satisfactory.

The brake consists of a magnetic clutch, operated by current from the motor acting as a generator, and bearing against the polished surface of a flat disc cast upon the wheel. One wheel on each axle is thus equipped. Figs. 1 and 2 show the arrangement of the coil and also the shape of the clutch; the latter for the purpose of removing it from the axle if desired. The same handle operates both brake and controller. When the "off" position is reached, a switch is automatically thrown which cuts off the

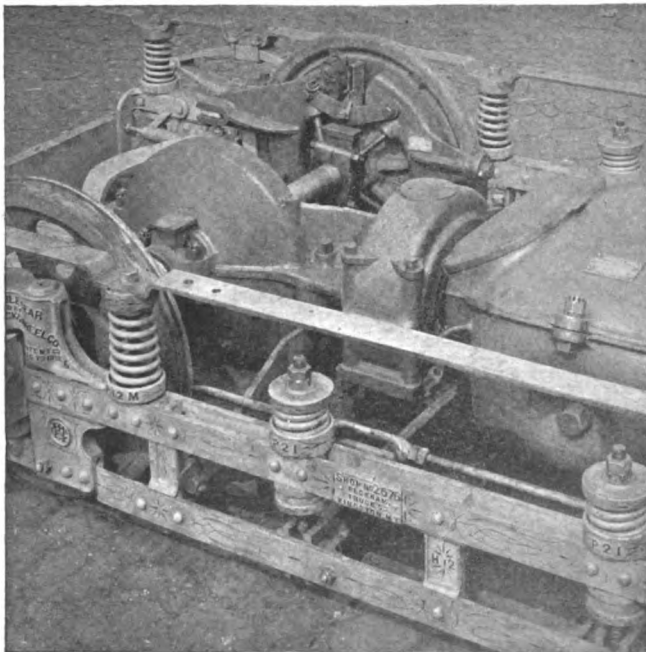


FIG. 3.—THE SPERRY ELECTRIC BRAKE.

trolley current and makes such connections that at the first point of the controller the motor and brake magnets are put in series with about 18 ohms resistance, when the motor "builds up" and sends a current through the brake magnets and resistance. When the controller is turned back to the "off" position it again trips a switch and throws in the trolley current. Fig. 3 shows the brake applied to a truck.

As soon as the wheels stop revolving the motor ceases to generate current, so that the slipping of the wheels is impossible.

The stops are said to be remarkably quick and smooth, as the pressure of the brake is hardest at high speed and is reduced gradually and automatically until the car stops.

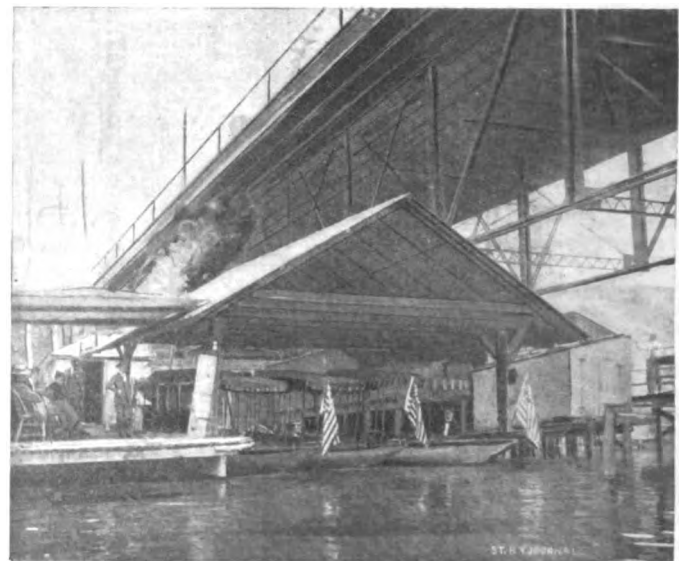
ELECTRIC LAUNCHES RUN BY RAILWAY CURRENT AT MILWAUKEE.

From time to time note has been made in these columns of the use of electric launches in connection with electric railroads, the



ELECTRIC LAUNCH IN SERVICE AT MILWAUKEE.

current for the storage batteries being taken from the trolley circuits, usually through a dead resistance. Such launches are in use at New Haven, Altoona, Milwaukee, Pueblo, etc.; and we show here the service that has been running all the summer at Milwaukee, on the river, starting from the end of the Cambridge



ELECTRIC LAUNCH DOCK, MILWAUKEE.

Avenue line. The Electric Launch Co. is a "wheel inside a wheel" being practically composed of stockholders in the Milwaukee Street Railway Co.; and Mr. Otto M. Rau, the well known electrician of the latter concern, is the manager of the launch company. Our illustrations, kindly loaned by the *Street Railway Journal*, show the launch station and one of the launches on the Milwaukee River. The trip is four miles, and a fare of 25 cents is charged. The service has proved popular on its own account and has also drawn travel along the line that reaches the launch

terminus. The three launches in commission were part of the World's Fair fleet, and were purchased from the company that had the concession, after being overhauled and fitted for their new duties.

STREET RAILWAYS IN MILWAUKEE.

AN important step has been taken by the City Council of Milwaukee, which, if carried out to the end proposed, will place that municipality in possession of its street railways and put upon the city officials the burden of their operation. Litigation and other troubles have been pending for some time between the municipality and the Milwaukee Street Railway Company. The contention has been that the taxes assessed on a valuation of \$2,800,000 were exorbitant, and seriously threatened the corporation with bankruptcy; whereas, the city maintains that the tax assessment is just, and proposes to take up the company's franchises by condemnation and purchase.

MISCELLANEOUS.

PROTECTION FROM LIGHTNING.—III.

BY ALEXANDER MCADIE, U. S. WEATHER BUREAU.

1. Erection of rods. Few questions have been so thoroughly discussed from practical as well as theoretical standpoints as that of the certainty of the protection afforded by properly constructed lightning rods. All barns and exposed buildings should have lightning rods. Ordinary dwellings houses in city blocks have not the need for rods that scattered houses in the country, and especially if on hill sides, have.

2. Use a good iron or copper conductor. If the latter, one weighing about six ounces to the foot, and preferably in the form of tape. If iron is used and it seems to be in every way as efficient as copper, have it in rod or tape form and weighing about 85 ounces to the foot. "A sheet of copper constitutes a conductive path for the discharge from a lightning stroke much less impeded by self-induction than the same quantity of copper in a more condensed form, whether tabular or solid." (Sir William Thomson.)

3. The nature of the locality (see chapter I) will determine to a great degree the need of a rod. Places apart but a few miles will differ greatly in the relative frequency of flashes. In some localities the erection of a rod is imperative; in others hardly necessary.

4. The very best ground you can get is, after all, for some flashes but a very poor one; therefore, do not imagine that you can overdo the matter in the making of a good ground. For a great many flashes an ordinary ground suffices, but the small resistance of $\frac{1}{10}$ ohm for an intense oscillatory flash may be dangerous. Bury the earth plates in damp earth or running water.

5. "If the conductor at any part of the course goes near water or gas mains it is best to connect it to them. Wherever one metal ramification approaches another it is best to connect them metallically. The neighborhood of small bore fusible gas pipes and indoor gas pipes in general should be avoided." (Lodge.)

6. The top of the rod should be plated or in some way protected from corrosion and rust.

7. Independent grounds are preferable to water and gas mains.

8. Clusters of points or groups of two or three along the ridge rod are recommended.

9. Chain or linked conductors are of little use.

10. Area of protection. Very little faith is to be placed in the so called area of protection. The committee that first gave authority to this belief considered that the area protected by any one rod was one with a radius equal to twice the height of the conductor from the ground. Many lightning rod manufacturers consider that the rod protects an area of radius equal to the height. The truth is that buildings are struck sometimes within this very area, and we now hold there is no such thing as a definite protected area.

11. Return shock. Some uncertainty exists on this point. The so-called "return stroke" is caused by the inductive action of the charged cloud on bodies within its influence, and yet some distance away from the place of the direct discharge. As explained by Lord Mahon, who first called attention thereto, the sudden return of the body charged inductively to a neutral condition, following the equalization at some distant place, is the cause of the return shock. We are beginning, however, to see more clearly into the character of the stress in the dielectric, preceding and during flashes, and it is only a question of time before the use of this term, "return shock," will be abandoned. Of far greater importance are the terms "recoil kick" and "alternative path," as shown experimentally by Lodge to exist.

12. Upward motion of stroke. There is no reason to doubt that the discharge takes place sometimes from earth to cloud. That is to say, that while we now consider a lightning flash as

something like the discharge of a condenser through its own dielectric, made up of excessively frequent alternations, say something like 300,000 times per second, the spark, or core of incandescent air, may seem to have had its beginning at the earth's surface. That is to say, the air gap breaks down first at a point near the earth.

13. Indifference of lightning to the path of least resistance. Nearly all treatises upon lightning up to within very recent times, assumed that lightning always followed the path of least resistance. "It is simply hopeless to pretend to be able," says Lodge, "to make the lightning conductor so much the easier path that all others are out of the question." The path will depend largely upon the character of the flash.

14. Any part of a building, if the flash be of a certain character, may be struck, whether there is a rod on the building or not. Fortunately, these are exceptional instances. The great majority of flashes in our latitudes are not so intense but that a good lightning rod, well earthed, makes the most natural path for the flash. We have many instances, however (not to be confounded with cases of defective rods), where edifices, seemingly well protected, have been struck below the rods.

15. Paradox of paradoxes, a building may be seriously damaged by lightning *without having been struck at all*. Take the famous Hotel de Ville of Brussels. This building was so well protected that scientific men pronounced it the best protected building in the world against lightning. Yet it was damaged by fire caused by a small induced spark near escaping gas. During the thunderstorm, some one flash started, "surging" in a piece of metal not connected in any way with the protective train of metal. The building probably did not receive even a side flash. This is, therefore, a new source of danger from within, and but emphasizes the necessity of connecting metal with the rod system.

16. Lightning does sometimes strike twice in the same place. Whoever studies the effects of lightning's action, especially severe cases, is almost tempted to remark that there is often but little left for the lightning to strike again. No good reason is known why a place that has once been struck may not be struck again. There are many cases on record supporting the assertion.

17. As lightning often falls indiscriminately upon tree, rock, or building, it will make but little difference sometimes whether trees are higher than adjoining buildings.

18. It is not judicious to stand under trees during thunderstorms, in the doorway of barns, close to cattle, or near chimneys and fire places. On the other hand, there is not much sense in going to bed or trying to insulate one's self in feather beds. Small articles of steel, also, do not have the power to *attract* lightning, as it is popularly put, or determine the path of discharge.

19. Unnecessary alarm. Just in advance of thunderstorms, whether because of the varying electrical potential of the air, or of the changing conditions of temperature, humidity, and pressure, and failure of the nervous organization to respond quickly, or to whatever cause it may be due, it cannot be denied that there is much suffering from depression, etc., at these times. It is, perhaps, possible that these sufferings may be alleviated. Apart from this, many people suffer greatly from *alarm* during the prevalence of thunderstorms, somewhat unnecessarily, we think. Grant even that the lightning is going to strike close in your vicinity. There are many flashes that are of less intensity than we imagine, discharges that the human body could withstand without permanent serious effects. Voltaire's caustic witticism "that there are some great lords which it does not do to approach too closely, and lightning is one of these," needs a little revision in these days of high potential oscillatory currents. Indeed, the other saying, "Heaven has more thunders to alarm than thunderbolts to punish," has just so much more point to it, as it is nearer the truth. *One who lives to see the lightning flash* need not concern himself much about the possibility of personal injury from that flash.

20. Finally, if you should be in the vicinity of a person who has just been struck by lightning, no matter if the person struck appears to be dead, go to work at once and try to restore consciousness. There are many cases on record proving the wisdom of this course; and there is reason for believing that lightning often brings about suspended animation rather than somatic death. Try to stimulate the respiration and circulation. Do not cease in the effort to restore animation in less than one hour's time. For an excellent illustration of a case of severe lightning shock and recovery, due, it would seem, to prompt action by the medical gentlemen present, all who are interested may consult the *Medical News*, August 11, 1888. A number of cases corroborative of this view are on record in various medical journals.

THE CORRESPONDENCE SCHOOL OF TECHNOLOGY, Cleveland, Ohio, has engaged Mr. J. N. Dodd, a graduate of Princeton and last year Fellow in mathematics at Princeton, as instructor in mathematics. The school reports growth, even though the times have been so excessively bad, and also has received many letters from its students commending the work.

THE ELECTRICAL ENGINEER.

[INCORPORATED]
PUBLISHED EVERY WEDNESDAY AT
303 Broadway, New York.

Telephone: 3860 Cortlandt. Cable Address: LENGINEER.

GEO. M. PHILIPS, President. F. R. COLVIN, Treas. and Business Manager.

Edited by
T. COMMERFORD MARTIN AND JOSEPH WETZLER.
Associate Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—630 Atlantic Avenue,
Boston, Mass.

Western Editor and Manager C. KAMMEYER, 1439 Monadnock Building, Chicago,
Ill.

New York Representative, 303 Broadway, } W. F. HANKS.
Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada, - - - - - per annum, \$3.00
Four or more Copies, in Clubs (each) 2.50
Great Britain and other Foreign Countries within the Postal Union " 5.00
Single Copies, - - - - - .10

[Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1893.]

EDITORIAL ANNOUNCEMENTS.

Addressee.—Business letters should be addressed, and drafts, checks and post-offices orders made payable to the order of THE ELECTRICAL ENGINEER. Communications for the attention of the editors should be addressed, EDITOR OF THE ELECTRICAL ENGINEER, 303 Broadway, New York City.

Communications suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.

VOL. XVIII. NEW YORK, SEPTEMBER 12, 1894. No. 332.

CONTENTS.

EDITORIAL :—	PAGE.
"Will o' the Wisp" Inventions.....	212
The Commercial "All Submarine" Cable.....	212
Electric Brakes.....	213
Dynamos and Drought.....	213
Graphite "Carbons".....	213

ARTICLES :—	PAGE.
Schroon Lake; The Summer Diversions of an Electrical Amateur (illustr.).....	201
The Duncan Alternating Current Meter (illustr.)..... W. S. RESOR.	204
Magnetic Leakage in Dynamo Electric Machinery.—III. (illustr.)..... A. E. WIENER.	205
The Commercial "All Submarine" Cable from New York to Europe (illustr.)..... E. W. S.	207
"Electrical Experts"..... CARL KAMMEYER.	208
Protection from Lightning.—III..... ALEXANDER MOADIE.	211
Preliminary Experiments to find if Subtraction of Water from Air Electrifies it..... LORD KELVIN, M. MACLEAN and A. GALT.	217

ELECTRIC TRANSPORTATION DEPARTMENT :—	PAGE.
The La Roche Electric Launch (illustr.)—Extending the Trolley in Brooklyn.—New Hellman Electric Locomotives.....	209
The Sperry Electric Brake (illustr.).....	210
Electric Launches Run by Railway Current at Milwaukee (illustr.).....	210
Street Railways in Milwaukee.....	211

NEWS AND NOTES :—	PAGE.
Carborundum in Europe.....	203
Village Telephone System for Cincinnati.....	208
Correspondence School of Technology.....	211
Dynamo vs. Cell in Cleveland.....	217

LETTERS TO EDITOR :—	PAGE.
Iron Wire in Armatures (illustr.)..... GILBERT WILKES.	214
" " " "..... C. P. POOL.	214
" " " "..... WM. HOCHHAUSEN.	214
Magnetic Leakage with Toothed Armatures..... W. A. ANTHONY.	214
Improvements in Arc Light Carbons..... A. E. WIENER.	215
Graphite Carbon from Ordinary Carbon..... E. G. ACHESON.	215
Electric Lighting Insurance..... ELIHU THOMSON.	215
" " " "..... G. E. COULSON.	215

SOCIETY AND CLUB NOTES :—	PAGE.
New York Electrical Society: Buffalo Bill under the Search Light.....	215

INVENTORS' RECORD :—	PAGE.
Classified Digest of U. S. Electrical Patents Issued August 28 and September 4, 1894.....	216

OBITUARY :—	PAGE.
Hermann von Helmholtz (portrait).....	217
Paul Lemonnier.....	217

TRADE NOTES AND NOVELTIES AND MECHANICAL DEPARTMENT :—	PAGE.
Ajax Multiple Fuse Lightning Arrester (illustr.).....	218
New Plant of the Baltimore Brush Co.—Recent Sales of Erie Ball Engines.—A Nice List of Dynamo and Motor Sales.—Bell Telephone Output.—Voluntary Receivership of H. Ward Leonard & Co.....	219
E. E. S. Knife Blade Switches (illustr.)—Bridgeport Machine Tool Works.—Western Notes.—New England Notes.—Philadelphia Notes.—Southern Notes.—Canadian Notes.....	220

"WILL O' THE WISP" INVENTIONS.

IT is curious to note the regularity with which certain ideas come into favor again with electrical inventors, after undergoing neglect and oblivion. Sometimes these ideas are deserving of renewed study in the fuller light of fresh truth; sometimes an original mind addresses itself successfully to the task from which others have fallen back defeated; sometimes the idea is put forward merely as a means of making money out of the unwary. But be the reason what it may, the period of quiet and forgetfulness is followed by one of activity as surely as day and night chase each other.

We do not undertake to say of any of these fugitive, "will-o'-the-wisp" inventions that they are useless or worthless. On the contrary, there are many among them that will yet be caught and made of great value; but it would often be better for everybody if the man who intended to "arrive" at the goal, acquainted himself first with all the blind alleys that other folk had strayed into. If would-be inventors read the electrical journals pretty closely they could avoid lots of hard, useless work and much unnecessary expense. They might also find out that it would be better to strike upon untraveled paths. Even if they did not reach Zipango, they would touch San Salvador.

The list of incompleted electrical inventions and of the things not yet perfected, though every new hand tries them, just as ambitious young histrians select Juliet and Hamlet—is a long and curious one. It includes thermopiles and pyro generators; primary battery lighting and the consumption of carbon in the cell. Then there are magneto telephony and talking across the Atlantic; as well as harmonic telegraphy and sending Morse over long ocean cables. In another field of work we have uni-polar machines, the change of alternating into direct currents, and, if we may include the comic with the serious, distributors for switching current into and out of groups of lamps so that a "taste" takes the place of a steady supply. In traction work, we have the fascinating suggestions of series working and of induction methods; while in heavier work yet, come the treatment of ores by direct electricity and the utilization of the tides and winds. Besides, there are many ideas that do not exactly require invention, but are lures in their way, like the use of iron wire in dynamos.

If we say that some of these things are hopeless, we would not discourage anyone from having his fling at them. He will learn a good deal by failure and will be in the glorious companionship of such men as Edison, Brush, Thomson, Tesla, Kelvin, Siemens and many another worthy. He will learn also that life is not wholly success, even at its best, and that success really means a good average of hits, with misses here and there between.

THE COMMERCIAL "ALL SUBMARINE" CABLE.

WE give an account elsewhere of the landing of the final shore end of the new Commercial Cable in New York city. This cable is "all submarine," and thus for the first time, the land line on this side is entirely eliminated. Just whether this is a gain or not remains to be seen; we incline to the opinion that it will be, and that the Com-

mercial Cable Co. will be rewarded by an immunity from interruption, due to broken land lines, and from trouble due to trolley induction or gas in the subways. The trolley problem has been more than once discussed in our columns by Mr. Cuttriss, the electrician of the Company, but as the trolley system in Brooklyn has been rapidly extending all the time, it cannot be said that the remedies brought forward in the discussion have kept pace with the disease.

As to better working and quick service, there can be no doubt that the Commercial Company's enterprise has once again given assurance of that. Moreover, in reference to speedy transmission, it has already been found that the new Commercial Cable gives an easy 40 words per minute over its 500 pounds of copper per mile, while it is claimed that the new Anglo-American with its 600 pounds can take 53. Such records permit of automatic sending, and we ought soon to have some more "ocean records" smashed. We are glad to believe that the revival of trade and the increase of commercial relations between Europe and America promises plenty of support for the new cables, and a fair return on the heavy investment that they represent.

ELECTRIC BRAKES.

SOME time ago THE ELECTRICAL ENGINEER discussed at length the causes which have led to the numerous accidents to persons from electric cars, and a number of competent electric railway experts expressed it as their belief that much of the trouble experienced was due to the lack of sufficient braking power on the one hand, and, on the other, to the difficulty encountered by the motorman having both hands occupied, one with the brake and the other with the controller. It was pointed out at that time that while this arrangement generally in vogue gives rise to but little embarrassment ordinarily, it was just in the case of emergency that it failed, owing to the motorman's losing his head; and it was also pointed out that this difficulty could be avoided by arranging the brake and controller so that both may be operated by the same handle.

A little consideration of the problem here presented will show that with the extent of motion required in a crank or lever to range, first over a series of controller contacts and then to apply the brake mechanically, in the usual way with the same lever or crank, would be difficult of attainment. The application of electrical braking methods greatly simplifies the case, and though we have heard much of how beautifully such a method would work in practice, little if any attempt has been made to apply it to every-day work. There are two methods of braking possible by the aid of the electric current, the first, by converting the car motor into a dynamo and the second by utilizing the current as an intermediary for the generation of magnetism to operate magnetic brakes. Both of these methods have been tried singly but it has remained for Mr. E. A. Sperry to apply them together, simultaneously, in the very ingenious arrangement illustrated on another page. The peculiar properties of this combined arrangement would seem almost to fill the requirements of the ideal brake and if the test of time should bear out the claims of the inventor, this form of brake is destined to a wide application.

DYNAMOS AND DROUGHT.

THE forest fires and other disasters due to the very prolonged drought from which the whole country has been suffering, have set people thinking as to causes and remedies, and as usual some very funny theories are propounded. Some of the New York papers, with all seriousness, give space to the proposition of Mr. J. S. Daggett that every dynamo be stopped for 48 hours, because the air is kept surcharged with artificial electricity, which dissipates the natural humidity. In order to prove his theory, Mr. Daggett would have to show that the dynamos have been unusually busy this summer. We all know that the contrary is true, and that owners of dynamos never have had less work for their machines. It might even be urged, with as much probability, that the drought is due to the inactivity of the dynamos. Mr. Daggett is no better than the Chinese, who some years ago cut down the telegraph poles across their country because they suspected them of having caused a very serious drought. Several heads have come off, and the poles are now going up again, such a theory being too wild even for China. Pretty much the same thing occurred in Alabama, when the erection of the first telegraph poles there was coincident with some very dry weather. Alabama now has lots of telegraph lines and scores of dynamos, but there is no evidence that her rainfalls are below the old average on that account. If Mr. Daggett had enunciated his theory in the middle of winter when the dynamos are running all the time, he might have gained a respectful hearing; but to propound it at a time when artificial lighting is at a minimum and when electric railway work is at its slackest, shows how little of a real weather prophet he is, how little able to read the signs of the times.

GRAPHITE "CARBONS."

THE publication in the ENGINEER of Aug. 29 of a note relative to an improvement in arc light carbons has served to call forth two interesting communications which we print on another page. It would thus seem that as far back as 1882 Prof. Elihu Thomson appreciated the value of a light-giving medium which would exceed in life the form of carbon ordinarily employed, and sought the solution in converting the carbon into graphite by the application of heat to the carbon directly, through the medium of the electric current. It seems a pity that Prof. Thomson should have abandoned his work in this direction, and now that attention has again been drawn to it so prominently we hope that something may be done in this most promising field. In the meantime we are glad to note that Mr. E. G. Acheson has turned his attention to the utilization of the graphitic by-products of his carborundum furnaces and we shall await with interest the outcome of experiments now being carried on to determine their value as arc light pencils.

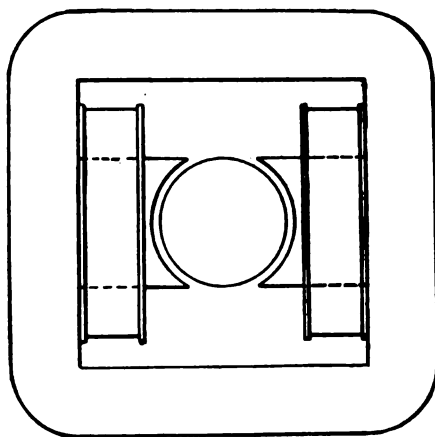
Prof. Thomson, it will be noted, still believes that graphite can be produced artificially on a considerable scale, in the manner pointed out, and if that be so there would seem to be one more bright opening for the utilization of Niagara power. Mr. Acheson is evidently of the same opinion.

LETTERS TO THE EDITOR.

IRON WIRE IN ARMATURES.

IN your editorial of August 22 on "Iron Wire in Dynamo Electric Machines," reference is made to a lecture delivered by me at the University of Wisconsin and afterwards published by the University. Though I have not a copy of the lecture now at hand, I think you have somewhat overstated me in saying that I recommended the use of iron wire both on armatures and fields of small machines up to 5 H. P. I think you will find that I recommended the investigation of the idea, as an encouraging possible solution of the question of reducing the abnormal cost of these small machines, stating that I had already succeeded in accomplishing the result with very small machines and with but little increased weight, and hoped soon to work on larger sizes, within the limit mentioned in the editorial.

In addition to the careful consideration given in your editorial it should be borne in mind that one important point that makes these small machines expensive is the disproportionate length of gap, owing to the winding on the armature being in several layers, and to the fact that the mechanical clearance and depth occupied by body insulation remain practically constant up to comparatively large sizes.



The reluctance of the gap in these small machines is much larger than is necessary for regulation and sparklessness. It was with the double idea of decreasing this reluctance (and thus diminishing the amount of field wire necessary) and of reducing the cost of the material used on the armature that iron wire for the armature was first considered.

As regards the inexpediency of using iron wire on the fields I do not agree with the opinion expressed in your editorial. The copper wire used on the fields of small machines is small in size, expensive and difficult to insulate with a thin cotton covering, and should therefore be improved upon if possible.

The remarks in the editorial concerning the increased leakage due to the use of iron wound field coils would apply strongly in the case of certain forms of fields, but the form which I had been discussing and which I had in mind was that of the accompanying sketch, in which the leakage is already low. Replacing the copper armature conductors with iron would still further decrease the leakage, which would not be materially increased by the presence of a field coil containing insulated iron wire and mounted in the position shown. In the case of the field coil, my idea was not to increase the cross section of magnetizable material in the magnetic circuit, but, if possible, to get something cheaper than copper to wind on the fields.

Other things being equal, the actual cost of the machine under the two systems of construction must of course determine which is the better.

DETROIT, MICH., Aug. 30, 1894.

GILBERT WILKES.

THE writer read with considerable interest the arguments advanced editorially in the *ENGINEER* of August 22, in favor of iron wire for small armatures and in opposition to the use of such wire for field magnet coils, and while agreeing in the main with the opinions set forth in that editorial would present a few suggestions not embodied therein.

That the use of iron wire for armature windings would be advantageous from a purely magnetic standpoint does not admit of argument, and the idea has been variously discussed on the other side of the Atlantic. The chief objection to the use of iron armature conductors seems to the writer to be a purely mechanical

one, i. e., the difficulty of handling the so much larger iron wire in the process of armature winding. Instead of increasing the size of the whole machine in order to make room on the armature core for the larger iron wire, as suggested in the editorial referred to, the writer would suggest keeping the field magnets the same size as though copper wire were to be used on the armature core, and decreasing the size of that core sufficiently to allow the proper quantity of iron wire to be used. The Foucault current loss could be reduced to a negligible quantity by stranding the conductors, and the hysteresis loss could not be excessive if the wire were thoroughly annealed.

It is the writer's opinion, however, that the most promising field for iron armature conductors (no pun intended) is in the construction of arc light dynamos where the armature conductors are always comparatively small. In a machine of the Brush type, for example, it would only be necessary to move the field magnets back away from the armature a sufficient distance to make room for the requisite number of layers of iron wire on the armature, while the projections between coils could be made much narrower, thus giving room for more wire, their chief function then being to drive the coils mechanically. A much stronger field would naturally result, due to the increased permeance of the space occupied by the armature windings, and, therefore, an increased output for a given speed and number of armature conductors.

The notion that an arc machine requires an excessive air-gap and a ridiculously small proportion of iron in the armature core has long been an exploded fallacy in the mind of the writer, who can see no logical reason why the magnetic circuit of an arc light dynamo should not be as nearly perfect as it can possibly be made. From this standpoint the use of iron armature conductors for arc-light machines means a considerable gain all around, while the diameter of the wire cannot get up to an uncomfortable size.

That iron wire will ever be universally used in the winding of constant potential armatures of low voltage is exceedingly doubtful, while its use in field magnet coils of any sort would appear to be prohibitive by reason of the very great increase in waste magnetism thereby engendered, as pointed out in the very able editorial already referred to. For winding constant current armatures the writer can see no reason why iron wire should not be universally used.

CRCIL P. POOLE.

LYNCHBURG, VA., Aug. 28, 1894.

If the advocates of the use of iron instead of copper wire for conductors on armatures should make a trial, as has been done by many dynamo constructors in the early days of the art, they would probably find that there is nothing to be gained by the change.

WM. HOCHHAUSEN.

BROOKLYN, N. Y., Aug. 27, 1894.

MAGNETIC LEAKAGE WITH TOOTHED ARMATURES.

I NOTICE in Mr. A. E. Wiener's article in the *ENGINEER* for August 22 the following statement: "In toothed and perforated armatures a portion of the magnetic lines of the main path enters the iron projections of the core and passes through the armature without cutting the conductors. This position, therefore, cannot be considered as useful," etc.

This might be understood to refer to the lines that pass in through the teeth and then through the body of the core. Of course, Mr. Wiener does not mean those, but the lines that pass along the surface of the armature from tooth to tooth outside the windings. Such lines not passing through the area enclosed by the coils are as much leakage lines as any that pass from pole to pole outside the armature. The number of such useless lines is greater the narrower the gap at the surface, and is especially large when the wires pass through perforations in the core, or where a toothed core is overwound with iron wire.

I have, however, not infrequently found the idea held that the lines which passed through iron beside the conductor could not cut it, and not long since an inventor came to me with a scheme for multiplying the E. M. F. in the so-called unipolar machine. He was certain he had solved the problem and that he could build a "unipolar" machine of any desired E. M. F.

His scheme was to place a conductor radially on the surface of the iron disc from a point between the centre and circumference, to the circumference, then back through a hole in the body of the disc toward the centre, out to the face, and along the face a second time to the circumference, and so on, as many turns as necessary. The theory was that as the disc revolved between the opposite poles of a magnet, the wires on the surface would cut all the lines, while the return wires through the holes in the metal would cut but very few lines, as nearly all the lines passing through the disc from face to face would pass through the solid metal.

He was very much disappointed when I told him that those conductors in the holes would cut the lines exactly as those on the surface and that if the two ends of his winding were joined, no matter after how many turns of the conductor, he would get no current in it; and that, to obtain any current in an outside

circuit, it would be necessary that one end of his winding terminate near the centre and the other toward the circumference, and that the E. M. F. he would thus obtain would be that due to a length of conductor equal to the radial distance between the terminals. I was very sorry to have to blast his hopes but there was no help for it; his beautiful solution of the problem had to go the way of a hundred others.

NEW YORK, Aug. 31, 1894.

WM. A. ANTHONY.

WITH a great deal of surprise I note the remarks of Messrs. Berg and Poole, on page 193 of your issue of September 5. With surprise, because both gentlemen criticise the figures given by me for the core-leakage, λ_1 , Table I., page 142, without knowing how I calculate the second factor, λ , of the product $\lambda^1 = \lambda_1 \times \lambda$. As there is quite a difference of opinion as to the modes of figuring the permeance of the air gaps of a toothed armature it would have been better had they waited with their criticisms until they had read the whole of my article.

The Table above referred to is the result of careful deductions from a large number of practical machines, the figures being obtained by calculating the frame-leakage, λ , of the machine by means of the formulæ given in sections of my article, and by dividing the value thus found into the known actual leakage, λ^1 , of the dynamo. Thus the calculations based upon these factors and upon my formulæ are bound to come out correctly, as will be seen from the results of the respective practical examples to be given at the end of my treatise.

Knowing that the magnetic leakage from tooth to tooth outside of the conductors is practically negligible, the existence of this factor λ_1 , led me to the theory of the core-leakage, which I explain in this way: If the armature remains stationary with relation to the field magnet, that portion of the lines of force entering the teeth, which is able to pass through their cross-section before saturation takes place, will reach the opposite pole without cutting any conductors. If, now, the armature revolves, that same number of lines will, in all positions, be able to pass through the armature core uselessly, and the number of lines of force cut at any one time by all the conductors of a toothed armature, therefore, will necessarily be smaller than the total number of lines emanating from the poles, in spite of the fact that every armature conductor cuts all the lines of force during each revolution.

With reference to the magnetic leakage, therefore, the iron projections of toothed and perforated armatures act, indeed, as a conglomeration of useless magnetic short circuits, but it must not be forgotten that, by bringing the iron of the armature closer to that of the field magnet, the reluctance of the air gaps is considerably reduced, thus cancelling the disadvantage of the core-leakage, and eventually enabling a toothed armature, by properly dimensioning the teeth, to even yield a greater useful flux than a smooth core armature, with equal magneto-motive force.

ALFRED E. WIENER.

SCHENECTADY, N. Y., September 6, 1894.

IMPROVEMENTS IN ARC LIGHT CARBONS.

IN your issue of August 29, there is a note, referring to "An Improvement in the Manufacture of Carbons," in which it is stated that MM. Despretz and Berthelot described before the Academy of Sciences, experiments made by them, resulting in the conversion of various forms of carbon into graphitic carbon, by exposing the carbon to a high temperature, and further, that MM. Girard and Street had applied this effect to the production of carbon for electrical uses.

My work on carborundum and its continued manufacture, naturally brought under my observation carbon at high temperatures, and more than one year ago my attention was drawn to the increased value of carbon for arc light rods and other electrical uses, as a result of its having been exposed to high temperatures. Even the impure carbons, as ordinary coke, are rendered pure and graphitic by this treatment; the impurities being volatilized at the temperatures employed.

Some few experiments were made in the direction of employing this pure graphitic carbon for arc lights, and also as electrodes for electrical furnaces. To obtain a more conclusive and practical test of its value, I wrote, under date of March 15, 1894, to one of our leading arc light carbon manufacturing companies, asking them if they would kindly try a quantity of this carbon for me, and receiving an affirmative answer, under date of March 17, I, on the 27th of the same month, shipped to their address, a large cask of the carbon; the total weight of carbon and cask having been 700 pounds.

Owing to pressure of work and other causes, the carbon was not used by them for some weeks, but during the last month, they have tested it, and while I am not yet in possession of full reports, it is understood that the results indicate a greatly reduced resistance, with increased length of life for the arc light carbons made from the purified material.

E. G. ACHESON.

MONROVIA, PA., Sept. 5, 1894.

GRAPHITE CARBON FROM ORDINARY CARBON.

IN your issue of Aug. 29, under the title "An Improvement in the Manufacture of Carbons" you refer to the fact that MM. Girard and Street have succeeded in manufacturing graphitic carbon from ordinary carbon by electrical heating.

I wish to say that so far from being a new process the same ground was covered by me as far back as 1882. At that time I converted ordinary carbon rods entirely into graphite, bent them, and otherwise treated them by passing such heavy currents through them as to bring their temperature almost to that of the positive crater in an electric arc. Based on this work I filed an application for a patent on the process and apparatus used, in February, 1883. This application fully described the method to be employed and the result—the manufacture of graphite artificially and the moulding of it, while hot, into the desired form on account of the plasticity it acquires at such extremely high temperatures. I believed then and still believe that with cheap power, graphite of fine quality may yet be made artificially on a considerable scale.

My patent application referred to above, was unfavorably received by the Patent Office, and the work was not pursued further, as, unless the process could receive protection, there would be no special object in building up an industry using it or based upon it.

My process also contemplated purifying the carbon by subjecting it to such high temperatures as would decompose and volatilize the impurities which it might contain. The fusing point of carbon is so very high that a block of carbon brought to the highest possible temperature would lose almost all its impurities, solid, liquid or gaseous, and the loss by radiation could be easily checked by coverings of porous and less conducting carbon. These matters were made subjects of the description filed more than eleven years ago.

It may be interesting to note also that I had in contemplation at the time the production of the heavy heating currents by transforming down from an alternating current as in welding metals by my process.

LYNN, MASS. Aug. 31, 1894.

ELIHU THOMSON.

ELECTRIC LIGHTING INSURANCE.

THIS morning I was informed by a local insurance agent of this town that all insurance companies required a permit from an electric company before they would insure where electricity was used as light, and that they will from this on demand 25 per cent. additional on all premiums where electric wires are used. This as you will see will have a tendency to keep out the user of electric light as many would-be users will say: "I cannot afford to put in electric lights as it will increase my insurance, etc., 25 per cent. more." Now in justice to electric companies I would like to have you put it before all those concerned and see if some remedy cannot be gotten up to meet the difficulties already thrown on the electric companies. I would suggest that the electric companies combine and form an Electric Insurance Co., make it strong, and let every secretary and treasurer act as agent for the general department.

GEO. E. COULSON,

Secretary & Treasurer Steelton Lt., Ht. & Pr. Co.
Steelton, Pa., Sept. 6, 1894.

(The state of affairs referred to by Mr. Coulson is not new, and it rests with the companies themselves to change it, first, by doing better work, and, next, by a proper scheme of self and mutual insurance. The latter has been tried and has failed, but might well be tried again. EDS. E. E.)

SOCIETY AND CLUB NOTES.

BUFFALO BILL UNDER THE SEARCH LIGHT.

By invitation of the Hon. W. F. Cody ("Buffalo Bill") and of the Edison Electric Illuminating Co., of Brooklyn, the New York Electrical Society visited Ambrose Park on Sept. 6 and inspected the lighting plant, witnessing the performance afterwards. The Buffalo Bill show at night is extremely interesting to electricians on account of the generous and skillful use made of the electric light. The plant was installed by the Brooklyn Edison Co. at very short order; the contract was given on April 15, this year, and the plant was ready 27 days later. At the water front of the 20 acre park is the station, which contains two Ball Erie cross compound engines of 300 H. P. each, two 250 H. P. Climax vertical boilers, and 4 No. 32 Edison dynamos. From this plant current is furnished to 800 16 c. p. incandescent lights, 77 Ward arcs of 2,000 c. p., 50 4,000 c. p. focussing Pieper lights, and 3 movable search lights of 10,000 c. p. each. The focussing lights are arranged around the huge arena, at a slight tilt, each having a 6-pound counterbalance to maintain steadiness in operation. The hand-feed search lights are mounted on the roof of the grand stand which seats 20,000 people, and are made to follow every movement of the various performers in a most clever manner.

By special courtesy, the members were admitted to the roof so that they could watch the manipulation of the searches and judge the effect, independently of the lights beneath. The value of the electric light for outdoor use could not be better demonstrated than it is during the wonderful performance of the "Rough Riders of the World." Mr. M. B. Bailey is in charge of the lighting.

The visitors who numbered over 200, including many ladies, were received by Mr. W. S. Barstow, of the Brooklyn Edison Co. who did the electrical honors most gracefully, pointing out many curious details, and betraying an intimate acquaintance as well with cowboy and Indian life as with electrical matters. After the performance, the party were grouped together in the arena under the glare of the search lights, with Buffalo Bill and Mr. Nate Salisbury, when a combined flash and search light photograph was taken. President Mailloux then offered the thanks of the Society to Col. Cody, who replied, remarking that the use of electric light had been very helpful to him, in his show, and that American apparatus had proved very satisfactory. Once in Germany, they had been promised that they would be surprised by some wonderful lighting there, but it didn't turn out half as well as that which they were using regularly. After three cheers for Buffalo Bill, the members dispersed. Secretary Guy is once more to be congratulated on the success attending his efforts to introduce into the Society programme meetings of combined amusement and instruction. The Society has prepared a most interesting series of lectures, entertainments, trips of inspection, etc., for the season of 1894-5, and all who desire to become members should apply to the Secretary, room 584 Temple Court Annex, Nassau street, this city.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED AUGUST 28, 1894.

Accumulators:—

Storage Battery, H. K. Hess, Syracuse, N. Y., 525,017. Filed Oct. 11, 1892. Employs a layer of quartz sand against the face of the active material and having its separate particles held together by a non-conductive adhesive material.

Storage Battery, H. K. Hess, Syracuse, N. Y., 525,018. Filed Feb. 13, 1893. Comprises a core of active material and opposite walls composed of quartz sand and elastic non-conducting binding.

Alarms and Signals:—

Electrical Fire Alarm Apparatus, E. W. Jungner, Stockholm, Sweden, 525,080. Filed Nov. 8, 1893.

Train Robber Alarm, M. Z. Levy, Kansas City, Mo., 525,082. Filed Mch. 27, 1894.

Electromagnetic Call Bell, J. J. Geary, Chester, Pa., 525,145. Filed Jan. 26, 1894.

Electric Bell, R. Varley, Jr., Englewood, N. J., 525,169. Filed Sept. 21, 1893.

Electrical Railroad Signal, W. F. Seymour, Mansfield, O., 525,290. Filed June 30, 1894.

A crossing signal for steam railroads.

Electric Alarm Clock, J. Slater, Hutchins, Pa., 525,391. Filed Nov. 9, 1893.

Conductors, Conduits and Insulators:—

Insulator, L. W. Bradley, Cleveland, O., 525,001. Filed Feb. 13, 1894.

Dynamos and Motors:—

Electric Motor, A. V. Meserole, New York, 525,108. Filed Jan. 8, 1891.

Employs a bi-polar armature, a fixed field ring and a fixed commutator together with a revolving brush on one side of the shaft and two similar brushes on the opposite side, one in advance of the other and each having independent insulated circuits.

Method of and Apparatus for Changing Period and Phase of Alternating Currents, C. S. Bradley, Avon, N. Y., 525,512. Filed July 10, 1893.

Claim 1 follows:—
The method of altering the frequency of an alternating current consisting in creating an alternating magnetic field by such current and rotating in said field a conductor or circuit so as to pass the poles of said field at a rate evenly divisible by or into the rate of the alternating current.

Galvanic and Thermo-Electric Batteries:—

Dry Battery, J. I. Solomon, New York, 525,235. Filed Apl. 11, 1894.

Employs a mixture of black oxide of manganese, granulated carbon and chloride of zinc and a granulated porous filling.

Lamps and Apparatuses:—

Manufacture of Carbon Filaments, T. A. Edison, Llewellyn Park, N. J., 525,007. Filed Dec. 15, 1893.

The method consists in forming a core of a substance soluble in water, coating the core with carbonizable material, dissolving the core in water and carbonizing the hollow frame.

Electric Arc Lamp, E. Thomson, Lynn, Mass., 525,084. Filed Jan. 24, 1894.

Employs a derived circuit coil or magnet acting against a retractor, and a feeding circuit comparatively independent in its feeding action but dependent for the times of action on the first magnet.

Electric Arc Lamp, E. Thomson, Lynn, Mass., 525,085. Filed May 16, 1894.

Claim 4 follows:—
In an electric arc lamp, a main circuit, a second circuit inductively related thereto and feeding mechanism controlled by the induced current.

Incandescent Electric Lamp Cut-Out, W. F. Smith, Philadelphia, Pa., 525,298. Filed Aug. 23, 1893.

A cut-out for series incandescent lamps consisting of a substance readily melting interposed in a shunt circuit together with a spring adapted to make contact when said substance melts.

Booster for Electric Light Wires, D. J. Cartwright, Boston, Mass., 525,315. Filed Jan. 16, 1894.

Miscellaneous:—

Feed-Alarm for Carding-Machines, W. W. Gordon, Hazardville, Conn. and T. F. Fry, Hartford, Conn., 525,018. Filed Aug. 26, 1893.

Means for Limiting Tension of Driving Springs, P. Wendelboe, New York, 525,087. Filed Feb. 27, 1894.

Water Purifier, H. Woods, Chicago, Ill., 525,303. Filed Sept. 15, 1893.

Claim 1 follows:

In a water-purifier, a voltaic pile having an adjustable end-plate with automatic means for taking up slight shrinkage of the pile.

Water Purifier, H. Woods, Chicago, Ill., 525,303. Filed Sept. 15, 1893.

Similar to No. 525,302.

Water Purifier, H. Woods, Chicago, Ill., 525,304. Filed Oct. 9, 1893.

Employs a water motor and an electric generator on a common shaft and a circuit from the generator, having terminals at opposite points in the feed water passage.

Water Purifier, H. Cassard, Chicago, Ill., 525,316. Filed Oct. 11, 1893.

Employs a voltaic pile having a channel leading from the perimeter to the centre of the pipe and a cap plate having a central opening.

Railways and Appliances:—

Trolley, N. W. Haskins, Brooklyn, N. Y., 525,015. Filed Dec. 1, 1893.

Consists of a plurality of grooved annular bearings at right angles to a common axis.

Trolley Wire Switch and Crossing, N. W. Haskins, Brooklyn, N. Y., 525,016. Filed April 23, 1894.

A switch and crossing provided with grooves to accommodate the peculiar form of trolley described in No. 525,015.

Switches and Out-Ofs:—

Circuit Breaker, C. O. Chesney, Pittsfield, Mass., 525,184. Filed July 6, 1891.

Employs a swinging bridge piece and weighted lever for breaking the circuit quickly, and carbon pencils forming a high resistance path for the circuit after the separation of the main contact points.

Circuit-Closing Device, J. J. Geary, Chester, Pa., 525,206. Filed Feb. 5, 1894.

A circuit closer adapted to electric bell and alarm circuits.

Telephones and Apparatus:—

Telephone Transmitter, J. & H. M. Goodman, Louisville, Ky., 525,201. Filed May 1, 1894.

The invention consists in arranging a movable magnet in such a manner as to receive the impulses from the diaphragm on the principle of a lever, such impulses being thus increased or diminished according to the point at which the connection is made.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED SEPTEMBER 4, 1894.

Accumulators:—

Electric Battery, L. Drescher, New York, 525,491. Filed March 23, 1894.

Claim 1 follows:

A galvanic cell having a chamber or vestibule formed in its end, the end walls of said vestibule being perforated.

Alarms and Signals:—

Frozen Water Alarm, W. Humberstone, London, Eng., 525,548. Filed May 14, 1894.

Adapted to use on boilers or water pipes exposed to cold to prevent bursting.

Railway Signaling by Means of Detonating or Explosive Signals, H. Brocklehurst, London, Eng., 525,584. Filed Nov. 2, 1893.

District Telegraph Call, W. H. Garven, Portland, Ore., 525,649. Filed Feb. 19, 1894.

Conductors, Conduits and Insulators:—

Underground Conduit, A. Segade and D. J. O. Regan, Detroit, Mich., 525,670. Filed March 6, 1894.

Employs an outer metallic sectional casing, joints connecting the adjacent sections, ducts of insulating material within the section and a filling of pulp around the ducts.

Distribution:—

Electrical Current Director, J. F. McElroy, Albany, N. Y., 525,354. Filed July 1, 1891.

The method consists in sending alternate current through separate opposite branches of the circuit, creating an opposing resistance alternately at opposite points of the branches, and finally directing the current from one branch through a main circuit and back through the other branch.

Electric Lighting System and Apparatus, E. Thomson, Lynn, Mass., 525,309. Filed Feb. 21, 1897.

A lighting system comprising arc and incandescent lamps, the former in series on a main circuit, and the latter supplied with current inductively by means of an induction coil.

System of Electrical Distribution, T. C. Coykendall, Rondout, N. Y., 525,445. Filed Jan. 4, 1894.

Relates to electric railway systems in which an electro-magnetic break switch is included in the main line and operated to break the circuit upon any sudden rise of current.

System of Electrical Distribution, T. C. Coykendall, Rondout, N. Y., 525,446. Filed Jan. 13, 1894.

Similar to No. 525,445.

Dynamos and Motors:—

Dynamo Electric Machine, J. F. McElroy, Albany, N. Y., 525,558. Filed Jan. 10, 1891.

Employs a circular range of fixed electromagnets divided into two groups, one having its coils connected with the magnetizing circuit and the other in the induced circuit.

Steam Turbine Dynamo, J. F. McElroy, Albany, N. Y., 525,590. Filed Dec. 19, 1893.

Employs a shaft consisting of a flexible portion carrying the armature and a rigid portion carrying the steam wheel and bearings supporting both portions in fixed relation to one another.

Controller for Electric or other Motors, E. A. Sperry, Cleveland, O., 525,394. Filed July 21, 1891.

Relates to devices for applying the brake or using the motor to brake the car, and interlocking devices between the operating handles.

System and Apparatus for Control of Electric Machines, E. A. Sperry, Cleveland, O., 525,395. Filed July 24, 1894.

Claim 6 follows:

In an electric machine, movable brushes for such machine, means of changing the inducing capacity of the machine at constant speed, in combination with a device for simultaneously shifting said brushes.

Alternating Current Motor, O. Dahl, Paterson, N. J., 525,447. Filed Dec. 8, 1892.

Employs an armature with two sets of windings, one distributed for the purpose of starting and the other concentrated for the purpose of synchronism.

Heating:—

Heat Regulator for Incubators, H. R. Davis, Cardington, Ohio, 525,490. Filed Aug. 31, 1893.

Lamps and Appurtenances:—

Handpiece for Portable Electric Lamps, A. Rockoff, New York, 525,564. Filed May 10, 1894.

Miscellaneous:—

Electric Lock, F. Apitz, Lockport, Ill., 525,400. Filed May 31, 1894.

Electric Cigar Lighter, A. C. Albertsen, Chicago, Ill., 525,437. Filed Nov. 29, 1893.

Rolette for Electric Light Wires, C. N. Hammond, Boston, Mass., 525,653. Filed Jan. 15, 1894.

Railways and Apparatus:—

Controlling Device for Electric Railway Cars, W. H. Conrad, Lebanon Pa. 525,336. Filed Jan. 8, 1894.

Provides means whereby the current is controlled and the power brake applied and released by means of a single lever.

Electric Railway System, F. B. Badt, Chicago, Ill., 525,460. Filed Oct. 22, 1892.

Employs a motor transformer mounted upon the car and operated by an external multiphase circuit, and one or more direct current motors geared to the axle and connected with the motor transformer.

Electromagnetic Car Brake, R. T. Murray & C. M. Allen, San Francisco, Cal., 525,505. Filed Oct. 24, 1892.

The invention consists in an electromagnetic brake applied to the track automatically by pressure upon the car fender.

Electromagnetic Tractile Device, C. M. Allen, San Francisco, Cal., 525,523. Filed Aug. 22, 1892.

Relates to means for increasing the tractile force of motors by vertically movable electromagnets acting upon the rails.

Conduit Electric Railway System, O. A. Enholm, New York, 525,539. Filed Apr. 17, 1894.

Employs a conductor composed of a series of insulated sections successively brought into contact with a main conductor by the passage of the car.

Overhead Switch for Trolley Wires, H. M. Greenwood, Brooklyn, N. Y., 525,598. Filed Dec. 1, 1893.

In an overhead frog, switch or crossing for trolley lines, a body, and wire arms, one of said arms adjustably connected to said body, whereby its position can be shifted to adapt it to the wires of the trolley line.

Switches and Cut-Outs:—

Electric Switch, G. F. Card, Covington, Ky., 525,332. Filed April 14, 1894.

A combined switch and blow out controlled by means independent of the electric current.

Electrical Cut-Out, A. Rockoff, New York, 525,563. Filed May 10, 1894.

Claim 1 follows:—

A cut-out having a socket comprising two compartments, spring contact pieces in the lower or inner compartment, plates on its exterior, and fusible wire or conductor between said plates.

R. Upton, Prof. E. L. Nichols and Dr. Pupin, who cherish his memory, and are proud of their close association with him.

By marriage Helmholtz became related to the distinguished Siemens family. One of his sons inherits not a little of the father's genius and ability.

PAUL LEMONNIER.

THE death is announced of M. Paul Lemonnier, of the old firm of Sautter, Lemonnier & Co., Paris, and a past president of the Société Internationale des Electriciens. His firm has long been engaged in electrical engineering and its work represents much that is best in modern French practice.

PRELIMINARY EXPERIMENTS TO FIND IF SUBTRACTION OF WATER FROM AIR ELECTRIFIES IT.¹

BY LORD KELVIN, P.R.S., MAGNUS MACLEAN, M.A., F.R.S.E., AND
ALEXANDER GALT, B.SC., F.R.S.E.

EXPERIMENTS with this object were commenced by one of us in December, 1868, but before any decisive result had been obtained, circumstances rendered a postponement of the investigation necessary. A glass U-tube with vertical branches, each 18in. long and about 1in. bore, with the upper 8in. of one of the branches carefully coated outside and inside with clean shellac varnish, was held fixed by an uninsulated support attached to the upper end of this branch. The other branch was filled with little fragments of pumice soaked in strong pure sulphuric acid or in pure water; and a fine platinum wire, with one end touching the pumice, connected it to the insulated electrode of a quadrant electrometer. A metal cylinder, large enough to surround both branches of the U-tube without touching either, was placed so as to guard the tube from electric influences of surrounding bodies (of which the most disturbing is liable to be the woolen cloth sleeves of the experimenters or observers moving in the neighborhood). This metal tube was kept in metallic connection with the outside metal case of the quadrant electrometer. The length of the exposed platinum wire between the U-tube and the electrometer was so short that it did not need a metal screen to guard it against irregular influences. An india-rubber tube (metal metallically connected with the guard cylinder would have been better) from an ordinary blow-pipe bellows was connected to the uninsulated end of the U-tube. Air was blown through it steadily for nearly an hour. With the sulphuric pumice in the other branch the electrometer rose in the course of three-quarters of an hour to about nine volts positive. When the pumice was moistened with water instead of sulphuric acid no such effect was observed. The result of the first experiment proves decisively that the passage of the air through the U-tube gave positive electricity to the sulphuric acid, and therefore sent away the dried air with negative electricity. A corresponding experiment with fragments of chloride of calcium instead of sulphuric pumice gave a similar result. In repetition of the experiments, however, it has been noticed that the strong positive electrification of the U-tube seemed to commence somewhat suddenly when a gurgling sound, due to the bubbling of air through free liquid, whether sulphuric acid or chloride of calcium solution, in the bend of the U-tube, began to be heard. We intend to repeat the experiments with arrangements to prevent any bubbling of the air through liquid. We have repeated our original experiment with pumice moistened with water in the insulated U-tube, and with an uninsulated U-tube filled with sulphuric pumice between the bellows and the insulated tube, so that the air entering it is artificially dried. With this arrangement the insulated U-tube was negatively electrified by the blowing of the air through it; but this electrification may have been due to the negative electrification of the dry entering air, to be expected from the result of our first experiment. We intend to repeat the experiment with artificially-dried and diselectrified air blown through the U-tube containing pumice moistened with water.

DYNAMO vs. CELL IN CLEVELAND.

THE POSTAL TELEGRAPH-CABLE Co. has dislodged 4,000 cells from its Cleveland office and has substituted dynamo current, furnished by a gang of Edison machines. Mr. Francis W. Jones, the company's electrician supervised the transfer. It is said that the Postal has already laid off over 90,000 cells in this manner. The Cleveland generators are run by motor.

A TRADE journal with a thousand subscribers often has a greater number of readers of the sort the advertiser wishes to appeal to than the daily paper circulating a hundred thousand copies.—*Printer's Ink*.

1. Read before the British Association, Oxford.

OBITUARY.

HERMANN VON HELMHOLTZ.



Baron von Helmholtz.

THE whole scientific world experiences a severe loss in the death from paralysis, at Berlin, on Sept. 8, of Hermann, Baron von Helmholtz. The death of this great physicist and physiologist was due, it is believed, to paralysis brought on by his accident in falling down the stairway of a steamer on his return trip from America last year. The work of von Helmholtz is well known. He was born in August, 1821, at Potsdam, Prussia, where his father was an instructor in the Gymnasium. His mother was a member of the branch of the Penn family that settled in Germany when the other branch took root in this country. At the age of 17, Helmholtz entered the Royal Military School at Berlin, where he took the course in medicine, and where he began the career of careful investigation that gave him his world wide reputation. He served as a hospital and army doctor, but began his work as an expositor of new scientific truth with his paper on the conservation of energy read before the Berlin Physical Society in 1847. He moved now in swift succession from Berlin to Königsberg, thence to Bonn, and thence to Heidelberg, where he did his most important work. His investigations and discoveries in fermentations, hearing, sound, optics, etc., went from stage to stage of significance and value, and found their expression in a notable series of papers, books and inventions. The last include his beautiful ophthalmoscope. Electricity naturally interested him greatly, and his deeper studies in electrodynamics may be said to have begun in 1861-2.

Honors were showered on this truly great man. He was elected a member of the French Academy. In 1873 the Copley medal was bestowed upon him by the Royal Society of England. In 1883, William I. of Germany raised him to the order of nobility, and in 1891, he was made president and director of the Imperial Technical Institute of Physics, at Charlottenburg. When he came to this country last year, he was elected president of the Electrical Congress of the World's Fair. A noteworthy reception was given to him at Columbia College by President Low; and at the College of Physicians & Surgeons he delivered a memorable lecture on his ophthalmoscope. Towards Americans and American work he displayed the utmost friendliness and good will. Among his students may be counted many Americans—such as Mr. Francis

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

AJAX MULTIPLE FUSE LIGHTNING ARRESTERS.

If all circuits were purely metallic, and the insulation to ground could be maintained well into the megohms, lightning protection would be a comparatively simple task, for there would then be no tendency towards arcing of the generator current at the discharge gap. Experience teaches, however, that electric circuits "don't stay put," and that high insulation is rather the exception than the rule on many of them, all of which is very detrimental to the discharge gaps of the arresters.

Wider discharge gaps have been used to avert this trouble; mechanical and magnetic contrivances have been resorted to with varying success; but, whenever the discharge gap of any arrester, that is connected to one side of an electric circuit having a "ground" on the other pole, is operated upon by a static discharge, the discharge points are always more or less injured by the consequent arcing of the generator current. It must, therefore, follow that one pair of discharge points will not remain intact when used on circuits of this class, as at each successive

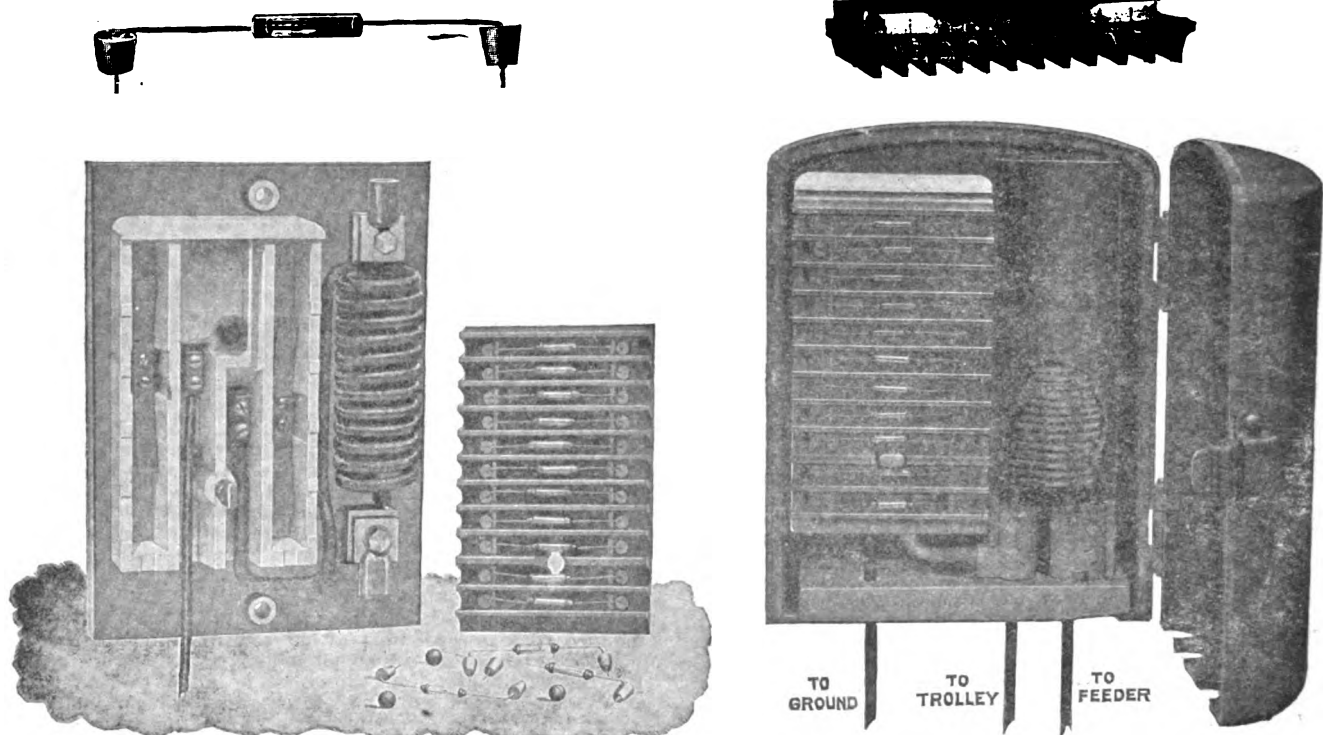
above position, and a small glass tube is hermetically sealed over this part of the fuse to keep the dischargers clean and dry until used.

The extreme sensitiveness of this part of the apparatus is made possible by its being called upon to act but once. The soft rubber plugs serve to hold the fuse in the corrugated cover of the arrester and the bare ends of the wire project through the cover, ready to be brought into contact with the line and ground terminals.

Into the back of the cover are pressed two strips of metal; one, a plain flat strip, to which is connected, by a long clamp, one end of each fuse; the other strip is U-shaped, and into it the remaining ends of the fuses project, but do not make contact with it, except as the carbon ball completes the connection.

In Fig. 2, the carbon ball is shown making contact between the top fuse and the U-shaped strip, which, when the cover is inserted in the porcelain back of the arrester, will receive metallic connection with the line terminal through the flat spring provided for that purpose in the channel at the right in the porcelain. A similar spring is in the left channel to connect the flat strip in the cover to the ground terminal. The line and ground terminals and flat contact springs in the porcelain backs are well illustrated in Fig. 3.

With the arrester thus assembled, it will be seen that only the top fuse has connection with the line terminal, and consequently is the only one that can be operated upon by a lightning discharge.



FIGS. 1, 2, 3 AND 4.—AJAX MULTIPLE FUSE LIGHTNING ARRESTER.

discharge the points are appreciably affected, and rendered less sensitive to the passage of the next discharge.

This is particularly true of arresters on single trolley railway circuits, where one side of the circuit is always grounded; and not infrequently a so-called automatic arrester is entirely destroyed by arcing.

In view of the difficulty attending the preservation of the discharge points of any arrester with a small air gap (and arresters must have small gaps to protect the finely wound coils of measuring instruments, as well as armatures and field coils), an idea presented itself, that a succession of very sensitive discharge points, one for each discharge, might be made more efficient and reliable for a given number of discharges than any one pair of points could be.

The Ajax arrester, manufactured by Mr. C. S. Van Nuis, of this city, is of the latter type, and consists chiefly of a porcelain arrester box, with a fibron cover containing eleven fuse dischargers.

The fuse, shown in Fig. 1, consists of two pieces of No. 26 brass wire, each about three inches long, having a single silk insulation and laid side by side for about one inch, as are consecutive coils in an armature. This one inch lap of the wires offers abundant surface for the discharge gap, which is formed by the two thicknesses of silk, and amounts to little more than .002 of an inch. Small pellets of a highly insulating wax secure these wires in the

The fuse may, or may not, be destroyed, depending upon the severity of the discharge and the condition of the line. If the line has a high potential and ground return, such as used on single trolley railway circuits, the static discharge will short circuit the generator current at the discharge points and the fuse will be completely vaporized by the current following the discharge, which will permit the carbon ball to fall to the next fuse, bringing it into circuit automatically, ready to receive a second discharge.

If a low potential metallic circuit is thus protected, one fuse may take care of several discharges, providing the circuit is perfectly free from grounds. If an accidental ground exists at the time of the discharge, the action will be the same as in the case of the railway circuit with the ground return. Or, if only a partial ground should exist at such time, the destruction of the fuse might not be complete; but the relative conductivity of the contact between the carbon ball and the small brass wire, as compared with the rest of the fuse, is so inferior in the former that the end of the wire supporting the ball is *always* the first to disappear, and is sure to allow the ball to drop and reset the arrester, even though the fuse should be only partially destroyed.

The standard types of arrester are adapted to all currents, up to 1,000 volts, whether having metallic or ground return circuits, but for higher potentials fuses with a slightly wider gap should be used.

Having reduced, as far as possible, the resistance and impe-

dance in the arrester and its ground connection, another important step toward the protection of the electrical apparatus will be accomplished by inserting a choke coil in the main circuit, so as to divert the lightning from it into the lightning arrester, and thence to the ground. For this purpose, the Ajax arrester is furnished with coils of various capacities to suit the carrying capacity of almost any circuit upon which it may be placed. For station use, the coil is necessarily of large dimensions, and is usually placed at the back of the switchboard. The arrester may be placed on the front of the board, and the connecting wires led through to it, or it may be put in any other place convenient for inspection. The dimensions of the arrester alone are 7 inches by 4½ inches by 2¼ inches.

The regular size is made with a 100 ampere coil, having coil and arrester mounted on a marble slab 7¾ inches by 11 inches by ¾ inch. For electric cars or pole line use, the arrester is placed in an asbestos lined iron box, Fig. 4, to protect it from the weather or external injury.

The number of arresters required to protect any plant against lightning must be determined by local conditions, such as the frequency and severity of thunder storms, the amount of natural protection afforded the line by adjacent objects, and the nature of the line itself.

NEW PLANT OF THE BALTIMORE BRUSH CO.

THE old plant of the Brush Company was destroyed by fire last October. A temporary frame building was immediately erected on the site of the one destroyed, and temporary machinery was installed to enable the company to promptly take up its city lighting contracts. A substantial brick building, which is absolutely fire proof, was erected over and around the temporary structure, which has since been removed. The temporary plant, with the exception of one engine and three dynamos, has also been torn down and shipped away. The new plant consists of four one-thousand horse-power vertical compound engines, manufactured by the Westinghouse Machine Company, of Pittsburgh, each directly connected upon the one bed plate with a one-thousand horse-power alternating current, two-phase Westinghouse dynamo, two 125-horse-power vertical compound engines, directly connected with two compound wound, direct current dynamos, and four 300-horse-power compound engines, each driving by means of belting six Brush arc-light machines.

There are yet to be installed one more of the thousand-horse-power engines and dynamos and six 300-horse-power compound engines for use on the arc light and electric power circuits.

For the present power service there are in use for the smaller-sized motors and elevators two 125-horse-power automatic compound engines, directly connected with two compound-wound, direct current dynamos of the railway-generator type. Part of the current generated by these machines is used to excite the fields of the larger alternating-current machines.

The switchboard is in two galleries, and is built entirely of marble and iron. When finished it will represent the newest ideas in electrical practice.

The installation of the new plant is under the supervision of Mr. W. J. Reilly, of Pittsburgh, who had charge of the installation and operation of the Westinghouse plant at the World's Fair.

The boiler-room is separated from the dynamo-room by a thirty-inch solid brick wall extending to the roof. The boiler-room contains five Climax upright boilers, twenty-five feet high. The interior shell of each of these boilers is three feet in diameter. The exterior diameter of the boilers is twelve feet. These are fitted with a double set of connecting pipes as a precaution against accidents. In addition to these there is a secondary battery of eight horizontal tubular boilers, with a total of 1,200-horse-power. The erection of two 700-horse-power Climax boilers is contemplated in the near future.

RECENT SALES OF ERIE BALL ENGINES.

THE Ball Engine Company, Erie, Pa., send another long list of their recent shipments of engines. This enviable condition of affairs is the result of the high reputation of their engines for electric light and railway work. Peninsula Electric Light & Power Co., Houghton, Mich., 1-350 H. P. tandem comp.; Union Colliery Co., Victoria, B. C., 1-160 H. P. engine; Edson, Moore & Co., Detroit, Mich., 1-80 H. P. engine; Noyes, Norman & Co., St. Joseph, Mo., 1-80 H. P. engine; City of Adrian, Adrian, Minn., 1-70 H. P. engine direct connected to Siemens-Halske dynamo; J. W. Parker & Co., New York City, 1-50 H. P. engine; Celadon Terra Cotta Co., Alfred Centre, N. Y., 1-100 H. P. engine; Norton Bros., Chicago, Ill., 1-150 H. P. cross comp.; Berwick Electric Light Co., Berwick, Pa., 1-160 H. P. engine; Sol. Heyman & Co., New York City, 1-60 H. P. engine; North Sub-District School, 4th ward, Pittsburgh, Pa., 1-85 H. P. engine; Geo. W. Childs Public School Building, Philadelphia, Pa., 1-60 H. P. engine; E. P. Dodge Mfg. Co., Newburyport, Mass., 1-50 H. P. engine; J. W. Parker & Co., New York City, for export, 1-80 H. P. engine.

A NICE LIST OF DYNAMO AND MOTOR SALES.

The following is a list of sales recently effected by Chas. E. Gregory & Co., Chicago:

Schneider Co., Garner, Ia., one 60 light United States plant; Rud. Lafferty, Chicago, one 1 H. P. C. & C. arc motor; Gardner-Morgan Electric Co. one 10 H. P. 220 volt Detroit motor; J. W. Alber, City, one 1 H. P. Crocker-Wheeler motor; Crane Elevator Co., Chicago, one 25 k. w. Westinghouse motor; C. C. Travis, Lacon, Ill., one 100 light Excelsior dynamo; Wilson & Jackson, Chicago, one 8 light arc plant, one 10 H. P. engine; C. R. Claghorn, Conemaugh, Penn., one 5 H. P. Crocker-Wheeler motor; R. Roach, Chicago, one 210 light Edison dynamo; Garabaldi & Cuneo, Chicago, one 1 H. P. C. & C. motor; Seeger, Guernsey & Co., City of Mexico, Mexico, one 50 light U. S. dynamo, one 100 light U. S. dynamo, and 1 H. P. Crocker-Wheeler motor; Geo. Cutter, Chicago, one 1 H. P. Crocker-Wheeler motor and one 450 light United States dynamo; Pontiac Electric Light, Heat & Power Co., Pontiac, Ill., one ¼ H. P. motor; Jorden Show Printing Co., Chicago, one 10 H. P. Edison motor; Capt. E. E. Napier, steamer "Mactawa," one 5 light Sperry arc plant; Plamondon Mfg. Co., Chicago, one 60 light United States plant; C. Shotte, Chicago, one 210 light Edison dynamo; Hatch Cutlery Co., Buchanan, Mich., one 25 k. w. Edison motor; University of Colorado, Boulder, Col., one 100 light Westinghouse plant; Northwest Fixture Co., Seattle, Wash., one 5 H. P. Sprague; Sargent & Lundy, Chicago, one 1 H. P. Crocker-Wheeler motor; Tuscaloosa Gas & Electric Light Co., Tuscaloosa, Ala., one 100 light United States plant; Champaign & Urbana Electric Railway Co., Champaign, Ill., one 10 H. P. Thomson-Houston motor; Tappan Steam Pump Co., Chicago, one 1 H. P. Crocker-Wheeler motor; Crane Elevator Co., one 1 H. P. Crocker-Wheeler motor; Windermere Hotel, Chicago, one 3 H. P. Sprague motor; D. S. Huff, Morris, Ill., one 50 light dynamo (United States); Charleston T.-H. Electric Co., Charleston, Ill., one 1 H. P. Crocker-Wheeler motor; Neuberger Bros., Chicago, one 1 H. P. Excelsior motor; Receivers of the Pennsylvania Steel Co., Steelton, Penn., sixteen standard arc lamps; Kuh, Nathan & Fischer, Chicago, two Ward arc lamps; Elmer P. Morris, Indianapolis, Ind., six Ward arc lamps; Robbins Electric Co., Pittsburgh, Penn., four Edison arc lamps.

BELL TELEPHONE OUTPUT.

THE Bell Telephone statement of output of instruments for the month and eight months ending Aug. 20 shows that there is at last a decided turn for the better in the affairs of the company, there being a good increase in gross output for the month, with a corresponding decrease of net returned. This is measured, however, against one of the worst months in the history of telephones.

For the eight months the statement is by no means so encouraging. It shows a very heavy falling off in the demand and a large increase in the number of returned instruments. But this covers a long continued period of depression, which is compared with a period of good business. The statement is:

For month ending Aug. 20:

	1894.	1893.	Dec.
Gross output.....	5,639	4,161	*1,528
Returned	6,531	6,596	65
Net return.....	842	2,435	1,593

For eight months since Dec. 20:

Gross output.....	53,144	63,637	10,493
Returned	46,960	39,348	*7,632
Net output	6,164	24,279	18,115

*Increase.

VOLUNTARY RECEIVERSHIP FOR H. WARD LEONARD & CO.

H. Ward Leonard & Company have voluntarily gone into the hands of a Temporary Receiver. H. Ward Leonard has been appointed Temporary Receiver for New York State, where the most important assets of the Company are located. The Receivership was, we are informed, the result of a friendly suit brought by the Interior Conduit and Insulation Co. at the request of H. Ward Leonard & Co., and the bill shows assets amounting to about \$177,000, and liabilities amounting to about \$63,000. One hundred and nine thousand dollars of the assets have been locked up in a suit against the Cayadutta Electric Railway Company for over a year past, and are likely to be so for several months to come.

H. Ward Leonard & Company being a foreign corporation and subject to attachment, the Directors deemed it best for the interests of the creditors and stockholders to place the affairs of the company in the hands of a Receiver until the settlement of this suit, when, it is claimed, there will be not only ample assets to settle all claims in full, but abundant means for the stock holders to resume business with.

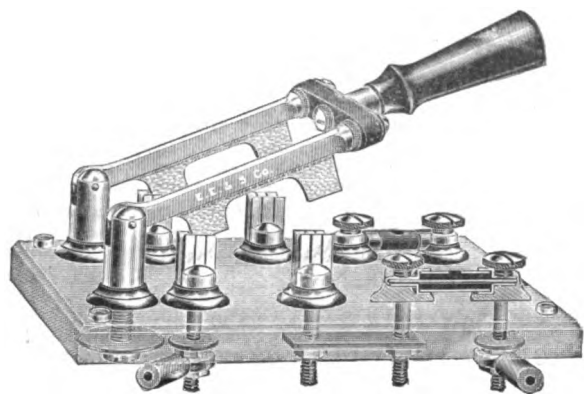
THE ESSICK PRINTER is being brought forward again, this time at Cleveland. It is an ingenious machine which sends and receives messages in typewriter form, on a regular sheet.

E. E. S. KNIFE BLADE SWITCHES.

The Electrical Engineering & Supply Co. of Syracuse, N. Y., call the attention of the electrical public to the improvements in knife blade switches of their manufacture.

The accompanying cut represents a double pole single throw switch mounted with fuse cut outs on the same base. The manufacturers have added to the neat appearance of the switch in making all terminal connections on back of the base, thus leaving out of sight the usual clumsy looking connections. The fuses are respectively surrounded by hard rubber tubes, one of which is shown in section. This device protects the finish of the base from injury in case a fuse blows. A small hole in the tube provides for the circulation of air. At each end of the hard rubber tube is fitted a metal cup and a tube in one, extending externally from the hard rubber tube. The bore of the metal tube is slightly greater than the diameter of the fuse wire. The metal tube is sawed so that as the fuse wire and holder complete rests in the socket of the base terminals, the knurled screw clamps firmly together fuse wire, brass tubes and base terminal.

This switch is especially designed for switchboard work where



E. E. S. KNIFE BLADE SWITCH.

economy of space is desirable, as the terminals do not require more than half the space of an ordinary switch, at the same time making it much neater in appearance and facilitating the back connections to quite a degree.

BRIDGEPORT MACHINE TOOL WORKS.

THE BRIDGEPORT MACHINE TOOL WORKS, E. P. Bullard, proprietor, have now been incorporated under the title of the Bullard Machine Tool Co., E. P. Bullard, president, and as such will continue the well-known business with which the proprietor has so long and so successfully been connected.

WESTERN NOTES.

MR. CHARLES WIRT, Chicago, is home from an eastern trip to New York and Boston.

PROF. J. P. BARRETT, City Electrician of Chicago, has returned from the convention of fire chiefs at Montreal.

CLEVELAND, O., will hereafter have a time ball, after the fashion of that on the Western Union tower in New York city.

THE COLUMBIA INCANDESCENT LAMP Co. of St. Louis has supplied over 6000 lamps for the grand new Union Station at St. Louis, Mo. The effect is very brilliant.

COL. W. E. BAILEY, the well known electrical contractor and promoter, of St. Louis, was in Chicago last week, arranging for the shipment of some electrical machines for several Missouri points.

THE CHICAGO CROSS ARM Co. report plenty of orders for their product, which consists of cross arms exclusively. Mr. Chas. S. Marshall, their vice-president, reports the indications for a good fall trade as very favorable.

THE JENNEY ELECTRIC MOTOR Co., Indianapolis, are moving to Springfield, Ohio, where they have secured the premises of the Whitley Reaper Works, consisting of splendidly equipped buildings located on 60 acres of ground.

NUTTING ELECTRIC MANUFACTURING COMPANY, Chicago.—This company, Mr. McFadden reports, will soon be ready to push the manufacture and sale of the Nutting arc lamp, otherwise known as the "wax-wheel" lamp; all differences between the two factions having been amicably arranged.

MR. JAS. WOLF is now in charge of the Chicago office of the N. Y. Insulated Wire Co., *vice* Mr. Olson, transferred to the New York office. Mr. Wolf will be remembered as having charge of the company's exhibit at the World's Fair.

THE JOHNSON ELECTRIC SERVICE Co., 39 Clifford Street, Detroit, Mich. (W. B. Roberts, general manager), send us their pamphlet illustrative of the Johnson system of heat regulation by means of electrical control. This system not only keeps the temperature uniform at a desired point, but effects a marked economy in the amount of fuel consumed. It is in use in hundreds of schools, hospitals, stores, dwellings, etc.

THE SUPERIOR LIGHT, HEAT AND POWER COMPANY, Chicago, have been sued by the Edison Electric Light Company for alleged infringement of the Edison patents for incandescent lighting and device for the distribution of light. The Edison company claim the sole right to use these patents in Chicago, and attached to their bill, have an exhibit reviewing a similar suit against infringers of the patent, which was decided in favor of the Edison company by the second circuit court of appeals of the United States.

THE CENTRAL ELECTRIC COMPANY has purchased the electrical house goods stock of the Detroit Electrical Works. The entire stock, consisting of iron and wood box bells; elevator, hotel, house and burglar alarm annunciators; metal, wood and hard rubber pushes, flexible cords, switches, etc., has been shipped to the Chicago store of the Central Electric Company. A new list has been issued by their House Goods Department quoting, it seems, unusually low prices for the grade of goods made by the Detroit Company. The circular states that prices given are good only so long as that special stock lasts.

THE ELECTRIC APPLIANCE COMPANY are making a specialty of prompt shipments on all orders for line material, shipping all orders for pins, brackets, cross arms and insulators from Chicago stock. Prompt and complete shipments of line material from Chicago stock will undoubtedly be appreciated by the trade who have been frequently inconvenienced by divided shipments of line material, partly from factory, and partly from Chicago stock. The Electric Appliance Company carries a stock of these goods which enables them to make carload shipments promptly from Chicago.

NEW ENGLAND NOTES.

CAPT. A. DE KHOTINSKY, late of the Germania Electric Co., has joined the staff of the Van Choate Electric Co.

THE WORTHINGTON HYDRAULIC WORKS at Brooklyn, N. Y., have decided to make large additions to their already extensive plant and have placed the contract for this work with The Berlin Iron Bridge Co., of East Berlin, Conn.

MR. A. B. FIELD, for several years with the General Electric Co. as salesman, very widely and favorably known in the Eastern States, has resigned from the General Electric Co. and will hereafter be identified with the Iona Manufacturing Co., of 336 Congress street, Boston.

BOSTON.—A contract for the completed work for the West End Street Railway Co.'s subway system has been awarded the National Conduit Manufacturing Company. This contract will amount to about \$60,000. The National Conduit Manufacturing Company feel very much elated over this, as they were brought in direct competition with every style of conduit system that is in use to-day.

PHILADELPHIA NOTES.

THE PHOSPHOR-BRONZE SMELTING Co. LTD., 2,200 Washington Avenue, Philadelphia, has erected a new foundry and increased the appliances in its mill. It has just issued its price list No. 9, which contains a large amount of data in compact form as to its many specialties.

SOUTHERN NOTES.

ATLANTA, GA. The petition for a thirty years franchise presented in behalf of the Standard Electric Co., of Chicago, has been refused by the city council.

CANADIAN NOTES.

MR. NESS, Montreal, is compromising with his creditors on the basis of 30 cents on the dollar, (25 cents cash), and hopes soon to resume business.

Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE Electrical Engineer.

Vol. XVIII.

SEPTEMBER 19, 1894.

No. 333.

ELECTRICAL MACHINIST PRACTICE.—I.

BY

James F. Hobart,

THE machinist who undertakes to construct or to repair electrical machinery, instruments and appliances, has much to contend with that is new to him. Not only are new forms and shapes of machine parts to be made, but new principles are to be learned, new "kinks" designed, and new methods followed.

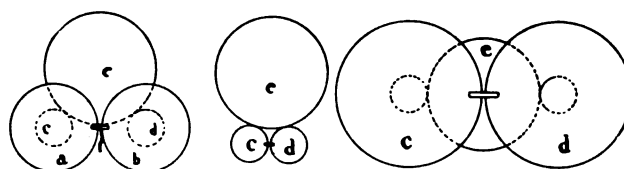
In all ordinary machine work motion is imparted from one body to another by friction, as in the case of belts, by the lever, screw, etc., but in electrical machine work, the transmission of force by magnetic power, eliminates the element of friction, in part, and in some instances wholly. Thus conditions arise, so different from the ordinary, that special and advanced methods of handling in the machine shop are especially, and often imperatively, desirable.

New materials are brought into the machine shop to be machined, and new tools and new methods of using existing tools have frequently to be invented to meet the demands made. In the manipulation of mica many new tools are necessary, as that material has to be flaked off into thin slices, then cemented with shellac into large blocks, from which pieces of any required size or shape may be cut, something that cannot well be done from natural pieces of mica.

By pressing the thin mica flakes into molds as soon as treated with shellac, and then driving off the solvent by

stay, and upon the accuracy with which the thin sheet iron core discs are made, depends to a great extent the value of the armature when finished.

To punch acceptable armature discs, several ways are open, to wit: By punching a single slot at a time, the blank being automatically revolved to bring it to the next slot; or a punch can be used which will punch out all the slots at once. These two methods are the ones usually followed, but the latter, the "whole punch" method, has proved very costly and unsatisfactory.



FIGS. 3, 4 AND 5.

The disc punched by this method is perfect, it leaves nothing to be desired; but the life of the punch is short. A set of dies (punch and matrix) for getting out discs with 45 to 95 slots, will cost nearly \$400. And several such dies have to my certain knowledge, failed (by breaking) in four or five weeks. The "whole punching" method is thus a costly one.

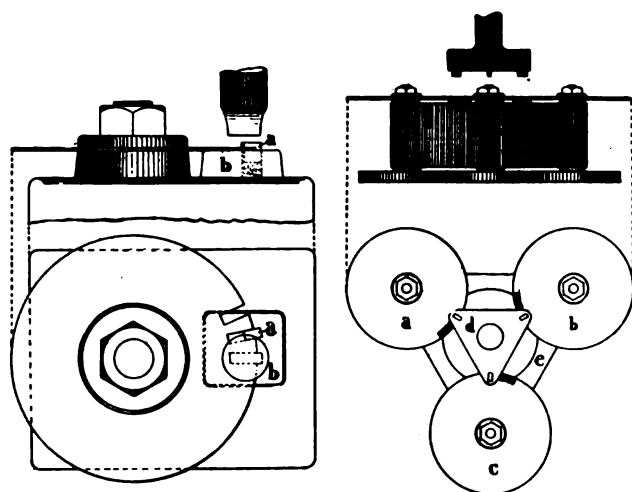
The "step by step" method of armature disc is thus the popular one. A great variety of detail is possible here. As stated, the blanks may be fastened upon an arbor, as in gear cutting; revolved by automatic attachment, or a stop may be adjusted and the discs revolved by hand as fast as the slots are punched out.

Fig. 1 illustrates this method. The stop *a* is made to slide very snugly in the bottom die *b*. When a new blank is put on the arbor, the stop *b*, is pressed downward by the blank. This is possible as the stop is mounted on springs for that purpose. As soon as one slot is punched, the blank is revolved by hand far enough to let the stop come through the slot already punched; this is continued until the slots have all been punched.

According to theory, this method is all right; but in practice, it does not always work well. The slots have more or less of a "fin" upon the lower edge, and the stop striking this fin or burr, is crowded one side to the extent of whatever lost motion there may be between the stop and slot. As a consequence, the error represented by the lost motion is repeated, and added with each slot that is punched. The result is that $\frac{1}{1000}$ of an inch, which does not matter if one slot is that amount out of line, becomes .095, or almost .1 inch in a blank with 95 slots. The effect of such work may be imagined when 200 or 300 discs are assembled together.

Another way of cutting armature disc slots, is to put a number on a screw arbor, clamp them together and cut all at once in a gear cutting machine. This method secures accuracy, but it is expensive. It is better to use the gear cutter index to lay off the holes, and let them be punched one by one in a fast working press.

A scheme proposed by Mr. James Brady, is shown in Fig. 2. Three blanks, *a*, *b* and *c*, each mounted on a sepa-



FIGS. 1 AND 2.

heat, any shape of mica work may be formed. For lining the wire grooves of armatures, this method of mica working alone, is invaluable.

In the punching of armature discs, a good deal of new machinist work has become necessary. The toothed armature for "iron clad" motors has probably come to

rate arbor, and geared together, by the central gear *e*, are brought within reach of the punch *d*, which is triangular in shape, and has three dies mounted upon it, one for each blank. Close running spiral gearing would be used between each blank and the index machinery, and three blanks could be cut at once, either the same, or of different sizes. The machine should be so designed that either head, *a*, *b* or *c*, could be withdrawn from beneath the punch for the purpose of changing blanks. The action of the machine would thus be continuous, two blanks being worked on while perhaps the third was being changed.

A modification of this device is shown by Fig. 3. It is much more simple, and cuts two discs at once with a single plain solid die, *f*. In this device, one of the heads shown in Fig. 2, is discarded. The two remaining can then be brought close together opposite each other, as shown in Fig. 3. The discs *a* and *b*, are attached to the gears *c* and *d*, which are connected to, and controlled by, the large gear *e*.

The range of this machine, is from two discs the size of the small gears *c* and *d*, (Fig. 4) to the two large discs shown at *c* and *d*, Fig. 5. The indexing may be done by a worm attached directly to the large wheel *e*.

MAGNETIC LEAKAGE IN DYNAMO-ELECTRIC MACHINERY.—IV.

BY

Alfred E. Whipple.

(c.) Relative average Permeance across the Magnet Cores. (P_r).

Since in dynamo-electric machines the magnet-cores, with their ends averted from the armature, are magnetically joined by special "yokes" or by the frame of the machine, forming the magnetic return circuit, the magnetic potential between these joined ends is practically = 0, while the full magnetic potential is operating between the free ends towards the armature. The average magnetic potential over the whole length of the magnet-cores, therefore, is one half of the maximum potential, and the average relative permeance, consequently, one half of that which would exist between the cores, if they had the same magnetic potential all over their length.

For the various forms of magnet-cores, by virtue of

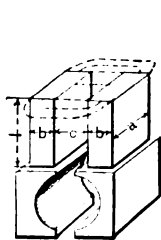


FIG. 12.

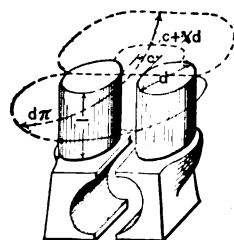


FIG. 13.

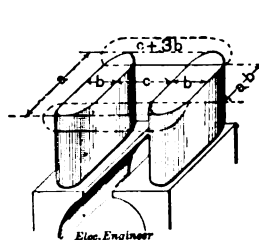


FIG. 14.

formulae (7) to (12), respectively, we therefore obtain the following relative average permeances:

1. Rectangular Cores.

The permeance between two rectangular magnet-cores, Fig. 12, is the sum of the permeances between the inner surfaces which face each other, formula (8), and between the end surfaces, which lie in the same plane, formula (9); and therefore the average permeance:

$$P_r = \frac{a \times l}{2c} + \frac{b \times l}{c + b \times \frac{\pi}{2}}, \dots\dots\dots (21)$$

where *a*, *b*, *c*, and *l* are the dimensions of the cores in inches, see Fig. 12.

2. Round Cores.

According to formula (11) we have in this case, see Fig. 13:

$$P_r = \frac{1}{2} \times \frac{d \pi \times l}{c + \frac{3}{4}d} = \frac{d \pi \times l}{2c + 1.5d} \dots\dots\dots (22)$$

3. Oval Cores.

For oval cores, Fig. 14, the permeance path consists of two parts, a straight portion between the inner surfaces,

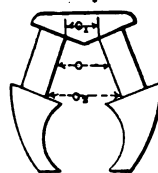


FIG. 15.

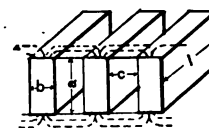


FIG. 16.

and a curved portion between the round end surfaces. Combining, therefore, formulae (8) and (11), we obtain:

$$P_r = \frac{(a-b) \times l}{2c} + \frac{b \pi \times l}{2c + 1.5b} \dots\dots\dots (23)$$

4. Inclined Cores.

If the cores, instead of being parallel to each other, are set at an angle, Fig. 15, the distance, *c*, in formulae (21), (22) and (23), respectively, has to be averaged from the least and greatest distance of the cores:

$$c = \frac{c_1 + c_2}{2}, \dots\dots\dots (24)$$

5. Multipolar Types.

In case of multipolar dynamos of *p* pairs of poles, the total permeance across the magnet-cores is 2 *p* times that between each pair of cores. In calculating the latter, it has to be considered that, while the permeance across two opposite side surfaces of the cores does not change by increasing their number, the leakage across two end surfaces is reduced, half of the lines leaking to the neighboring core at one side, and half to that at the other side.

For rectangular cores, therefore, we have, with reference to Fig. 16:

$$P_r = 2p \times \left[\frac{a \times l}{2c} + \frac{\frac{1}{2}b \times l}{c + b \frac{\pi}{4}} \right] = p \times \left[\frac{a \times l}{c} + \frac{b \times l}{c + b \frac{\pi}{4}} \right]; \dots\dots (25)$$

for round cores, according to formula (12):

$$P_r = 2p \times \frac{d \pi \times l}{2(2c + .6d)} = p \times \frac{d \pi \times l}{2c + .6d}; \dots\dots (26)$$

and for oval cores:

$$P_r = p \times \left[\frac{(a-b) \times l}{2c} + \frac{b \times \pi \times l}{2c + .6b} \right] \dots\dots\dots (27)$$

In multipolar machines, for *c*, the smaller of either the mean distance between two magnets, Fig. 17, or twice the mean distance between magnet-core and yoke, Fig. 18, is to be taken.

6. Iron Clad Types.

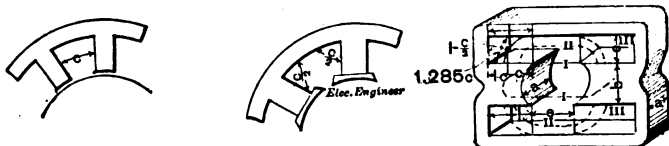
In certain types of dynamos, known as "Iron Clad" forms, the magnet-cores are not side by side of each other, but lie in line and are faced by the yokes connecting the same (Figs. 19 and 20).

a. Bipolar Iron Clad Type.

Considering that in the ordinary bipolar iron clad type, Fig. 19, the magnetic potential between the pole-ends of the cores is unity, between the yoke-ends, however, is zero, and at intermediate points, consequently, is given by the ratio of the distance from the yoke to the entire length of the core, and further that only half the magnetic

potential exists between the poles and the yokes, and that, therefore, the average potential between cores and yokes at any point is but one quarter the maximum potential of the core at that point, we obtain the following expression for the total average permeance between the cores :

$$P_1 = \frac{b \times l}{e + l \times \frac{\pi}{2}} + \left(1 + \frac{l-c}{l}\right) \times \frac{a \times c}{e + c \times \frac{\pi}{2}} + \frac{l-c}{l} \times \frac{a \times \left(l - \frac{c}{2}\right)}{1.285 c} \dots \dots \dots (28)$$



FIGS. 17, 18 AND 19.

In this formula it is assumed that the leakage-lines pass directly across the entire length of the end-surfaces of the cores, paths I, I, Fig. 19, of which the average permeance is one half that between the poles, but directly across the top and bottom surfaces only along a distance from the polecorners equal to the distance, c , between cores and yokes, paths II, II; from the remainder of the length of the top and bottom surfaces the lines pass to the yokes, the mean area of these paths, III, III, being

$$\frac{1}{2} [a \times (l-c) + a \times l] = a \times \left(l - \frac{c}{2}\right),$$

and the mean length

$$\frac{1}{2} \left(c + c \times \frac{\pi}{2}\right) = \frac{1}{2} \left(1 + \frac{\pi}{2}\right) \times c = 1.285 c.$$

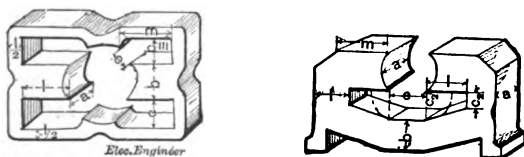
The magnetic potential at the leakage-division point of the core is $\frac{l-c}{l}$, the mean potentials of the pole and yoke-ports of the core, consequently, are

$$\frac{1}{2} \left(1 + \frac{l-c}{l}\right) \text{ and } \frac{1}{2} \left(\frac{l-c}{l}\right),$$

respectively, and the average potentials of the paths II, II, between the pole portions of the cores, and of the paths III, III, between the yoke-ports of the cores and the yokes, are

$$\frac{1}{2} \left(1 + \frac{l-c}{l}\right) \text{ and } \frac{1}{4} \left(\frac{l-c}{l}\right),$$

respectively.



FIGS. 20 AND 21.

β. Fourpolar Iron Clad Type.

If the magnets are so wound that consequent poles are produced in the yokes, Fig. 20, then the full magnetic potential prevails between the cores and the yokes, and the average potential along their length is one half the potential between the poles. For the fourpolar iron clad type, Fig. 20, having two salient and two consequent poles, the permeance between the cores, consequently, is:

$$P_1 = \frac{a \times (l+m)}{c} + \frac{b \times (l+m)}{c + b \times \frac{\pi}{4}} \dots \dots \dots (29)$$

Here all the leakage is assumed to take place between the cores and the adjacent yokes, for in this type the distance, e , between the pole-corners is generally not much smaller, if any, than the distance, c , between cores and yokes, and consequently no additional leakage needs to be considered at this point, unless separate polepieces are used, (see formula (39)).

There being no further stray paths in the types considered, formulæ (28) and (29) give the total stray permeances of the bipolar and fourpolar iron clad types, respectively.

7. Horizontal Double Magnet Type.

This type, Fig. 21, of which the bipolar iron clad type can be considered a special case, concerning the magnetic potentials of the leakage paths, has features similar to the iron clad form, and the permeance across the magnet-cores of the horizontal double magnet type, which, at the same time is its total waste permeance, accordingly can be expressed by the formula:

$$P_1 = \frac{b \times l}{e + b \times \frac{\pi}{2}} + \frac{1}{2} \left\{ \frac{a \times m}{e + m \times \frac{\pi}{2}} + \left(1 + \frac{l-c_1}{l}\right) \times \frac{a \times c_1}{e + c_1 \times \frac{\pi}{2}} + \frac{\frac{l-c_1}{l} \times a \times \left(l - \frac{c_1}{2}\right)}{\frac{1}{2} (c_1 + c_2)} \right\}, \dots (30)$$

in which $\frac{l-c_1}{l}$ is the magnetic potential at the leakage division points of the magnet-cores.

A SUGGESTED EXPLANATION OF THE SECULAR VARIATION OF TERRESTRIAL MAGNETISM.

THE author first called attention to the importance of ascertaining whether or no the interplanetary space should be considered a conductor of electricity. If so the earth's rotation would induce currents acting mechanically to increase the length of the day, and magnetically to displace the magnetic axis. The mathematical solution of the problem may be obtained by Lamb's equations for currents induced in spherical conductors, and the principal results, supposing the sphere to be uniformly magnetized about an axis not coinciding with that of rotation, may be stated as follows:

1. The mechanical reactions on the earth of currents induced in space, assumed to be a conductor of electricity by the rotation of its magnetic system, are insufficient to produce an appreciable lengthening of the day in historical times, unless the conductivity lies within certain narrow limits. The absence of any marked effect cannot, therefore, be brought forward as an argument against the conductivity of space.

2. The magnetic reactions of the same current, taken in conjunction with the secular cooling of masses of iron inside the earth, tend to produce a displacement which in kind is the same as that actually observed in the secular variation. But whether quantitatively the variation can be explained in this way is very doubtful.

MOTORS FOR FARMERS.

AT Allentown, Pa., Mr. Jeremiah Roth has erected poles and strung wire to his stock farm north of the fair grounds, where he has placed an electric motor. The power is supplied by the Traction Company, and by the use thereof Mr. Roth threshes his grain, cuts and grinds his feed and pumps water. He is giving exhibitions of it, and farmers, mechanics and others who are interested are invited to see this machinery in operation.

1. Abstract of a paper read by Arthur Schuster, F. R. S., before the British Association at Oxford.

THE ELECTRICAL ENGINEER.

[INCORPORATED]
PUBLISHED EVERY WEDNESDAY AT
303 Broadway, New York.

Telephone: 3860 Cortlandt. Cable Address: LENGINEER.

GEO. M. PHILIPS, President. F. R. COLVIN, Treas. and Business Manager.

Edited by
T. COMMERFORD MARTIN AND JOSEPH WETZLER.
Associate Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—630 Atlantic Avenue,
Boston, Mass.

Western Editor and Manager C. KAMMEYER, 1439 Monadnock Building, Chicago,
Ill.

New York Representative, 303 Broadway, } W. F. HANES.
Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada, - - - - -	per annum, \$3.00
Four or more Copies, in Clubs (each) - - - - -	2.50
Great Britain and other Foreign Countries within the Postal Union " - - - - -	5.00
Single Copies, - - - - -	.10

[Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1893.]

EDITORIAL ANNOUNCEMENTS.

Addresses.—Business letters should be addressed, and drafts, checks and post-offices orders made payable to the order of THE ELECTRICAL ENGINEER. Communications for the attention of the editors should be addressed, EDITOR OF THE ELECTRICAL ENGINEER, 303 Broadway, New York City.

Communications suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.

Advertisements.—We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers.

VOL. XVIII. NEW YORK, SEPTEMBER 19, 1894. No. 333.

CONTENTS.

EDITORIAL :—	PAGE.
Electrical Work in Canada.....	224
Paralleling Steam Roads.....	224
Adverse to "Controlling Patents".....	225
Electrical Machinist Practice.....	225
ARTICLES :—	
Electrical Machinist Practice.—I. (Illustr.).....	J. F. HOBART. 231
Magnetic Leakage in Dynamo-Electric Machinery.—IV. (Illustr.).....	A. E. WIENER. 233
The Development of Electric Manufacturing in Canada (Illustr.).....	T. C. MARTIN. 237
Protection from Lightning—IV. (concluded).....	ALEX. MCADIE. 241
NEWS AND NOTES :—	
A Suggested Explanation of the Secular Variation of Terrestrial Magnetism.....	223
Motors for Farmers.....	223
LETTERS TO EDITOR :—	
Iron Wire in Armatures.....	F. B. CORRY 241
LEGAL NOTES :—	
Edison Feeder and Main Patent Declared Void.....	242
SOCIETY AND CLUB NOTES :—	
Pennsylvania Street Railway Association.....	242
American Institute of Electrical Engineers.....	243
National Electric Light Association.....	243
TRADE NOTES AND NOVELTIES AND MECHANICAL DEPARTMENT :—	
The Rushmore Search Light (Illustr.)—Vandergrift's United States Tariff, 1894.—The Harrisburg Ide Engine Art Portfolio.—Bristol Recording Instruments.—The La Roche Catalogue.....	243
The Sweet Limit Switch (Illustr.)—Berlin Iron Bridge Co.—Efficiency of Mather Motors.—Ball Engines.—Brady's Safety Wire Cutter (Illustr.)—Western Notes.....	244

ELECTRICAL WORK IN CANADA.

IN view of the fact that the Canadian Electrical Association holds its annual meeting at Montreal this week, we have ventured to devote part of our space to an article giving an idea of the extent and perfection to which electrical manufacturing has already been carried in Canada. It must be obvious that a country which can support such industries must be a good market and must be well in touch with all the modern work in electrical applications. In the utilization of water-powers by electricity Canada has already done much, and is on the road to do a great deal more; while the development of her western territory has created several new opportunities for the use of electrical goods and apparatus. We are glad to extend our congratulations to the members of the Canadian Association on the magnitude and prosperity of the industry they represent, and can only hope that while they thus develop their own resources they will at the same time remain in the most cordial and intimate relations with their fellow workers on this side of the Great Lakes.

PARALLELING STEAM ROADS.

ELECTRIC railways for city and suburban passenger traffic have proved such good investments that the extension of this method to lines connecting adjacent towns was but a natural step. The additional revenue to be derived from these lines in the transportation of freight as well as passengers is also an important factor in estimating upon the income of such roads and hence it is not surprising to note the steps which have been taken in many directions towards the building of electric railroads into districts not heretofore reached by the steam road. Up to within a comparatively short time these country roads were looked upon with favor by the steam railway companies, who welcomed them as valuable feeders to their own systems, and they encouraged the idea to the fullest extent. What makes such roads all the more popular is the generally bad condition of public highways, and it is probable that in this direction will be found the relief so long sought for. But it would seem that, not content with the mere office of acting as feeders for the steam roads, a number of electric railways, such as that now in course of construction between Philadelphia and New York, are actually paralleling steam roads; and other similar roads contemplated, especially in New England, would make it appear that the steam roads will soon have to face a problem the solution of which may bring about a most radical modification in their method of operation.

It must be apparent that an electric railway, taking up and letting off passengers at any point on the line, possesses advantages which go far towards outweighing lower speed as compared with the steam roads; and even this comparison may be only fairly made with respect to express trains on steam roads, for it is safe to say that the speed of electric intra-urban roads would compare favorably with that of most of the way trains on this continent at the present time.

But while steam railway managers have looked with complacency upon the electric roads as feeders to their own systems they have in more than one instance of late

had to face the electric road as a competitor; and we believe the time is not far distant when a serious struggle for supremacy between the two, at least for short haul traffic, will be in full progress.

We can find no better illustration of the gradual reaching out of the electric railway than is presented by the conditions existing in the State of Connecticut where electric roads are gradually but surely paralleling the main steam lines such as the New York, New Haven & Hartford, and the New York & New England Railroads, and must eventually drain them of much of their local traffic. That the officials of these steam roads foresee the impending struggle crops out in some very significant remarks recently made by one of them. In the opinion of that official, if such competition should ever become serious he could see no reason to prevent the steam roads from electrically equipping the two outer tracks of their four track systems, and thus meeting the electric roads on their own ground. It must be admitted that this argument is unanswerable, but the wonder is that with the full knowledge of the coming course of events steam railroad managers should want to delay longer a step which they confess they may soon have to take. The remedy here proposed is of course only applicable to four track roads, whose number can be counted on the fingers of one hand, so that there is little to interfere with the prospects for remunerative business for the cross-country electric railway. On the other hand there is no good reason why single or double track steam roads should not avail themselves of the opportunity, and by constructing auxiliary parallel lines to their own roads reap the profit which will inevitably go elsewhere unless they act promptly and with decision.

ELECTRICAL MACHINIST PRACTICE.

EVERY new art must, of necessity, draw upon the older arts, for a time at least, until it has worked out by experience the methods and apparatus best suited to its practice. The electrical arts, and more especially that of dynamo construction, are, it is true, largely based on well known principles of mechanical construction but no one who has followed closely the practice in our best electrical shops can have failed to note the many instances in which the new art has given birth to special tools, and methods, not to speak of the numerous "wrinkles" and dodges which tend so much to facilitate and cheapen manufacture. To cite but two examples we need only refer to the numerous devices employed for slotting the teeth of armature discs; and again the variety of methods for constructing commutators. The knowledge of the practice of the best shops in these various important details must be of value to all engaged in construction of dynamo and kindred machinery and with the view of affording our readers an opportunity of comparing the various methods in practical use we begin this week a series of articles on "Electrical Machinist Practice," from the pen of Mr. James F. Hobart. The author of these articles treats his subject entirely from the standpoint of actual practice, and his own experience eminently qualifies him for the task he has undertaken. While Mr. Hobart's articles will range over a variety of topics we will be glad to receive from our readers any suggestions as to topics for treatment, as well

as any methods coming under their experience, not specifically treated of in the series.

ADVERSE TO "CONTROLLING" PATENTS.

NOTE is made in our Legal Notes of the important decision by which the Court of Appeals has reversed the New Jersey Circuit decision of March, 1893, sustaining the Edison "feeder and main" patent. Judge Acheson declares that the plan of electrical distribution covered by the claims of the patent is not an inventive creation, and that to sustain such claims would be to create a monopoly in that which belongs to the public. The Court says:—

"The claims with which we are concerned, as we have seen, are each for a combination of two elements, a consumption-circuit and feeding-conductors having respectively the peculiar properties specified. The primary question for solution, then, is, whether it involved invention in a patentable sense to combine a circuit for feeding only with a consumption-circuit the main conductors of which are so proportioned as to maintain such uniformity of pressure upon them that there is practically no variance in the candle-power of the lamps connected therewith.

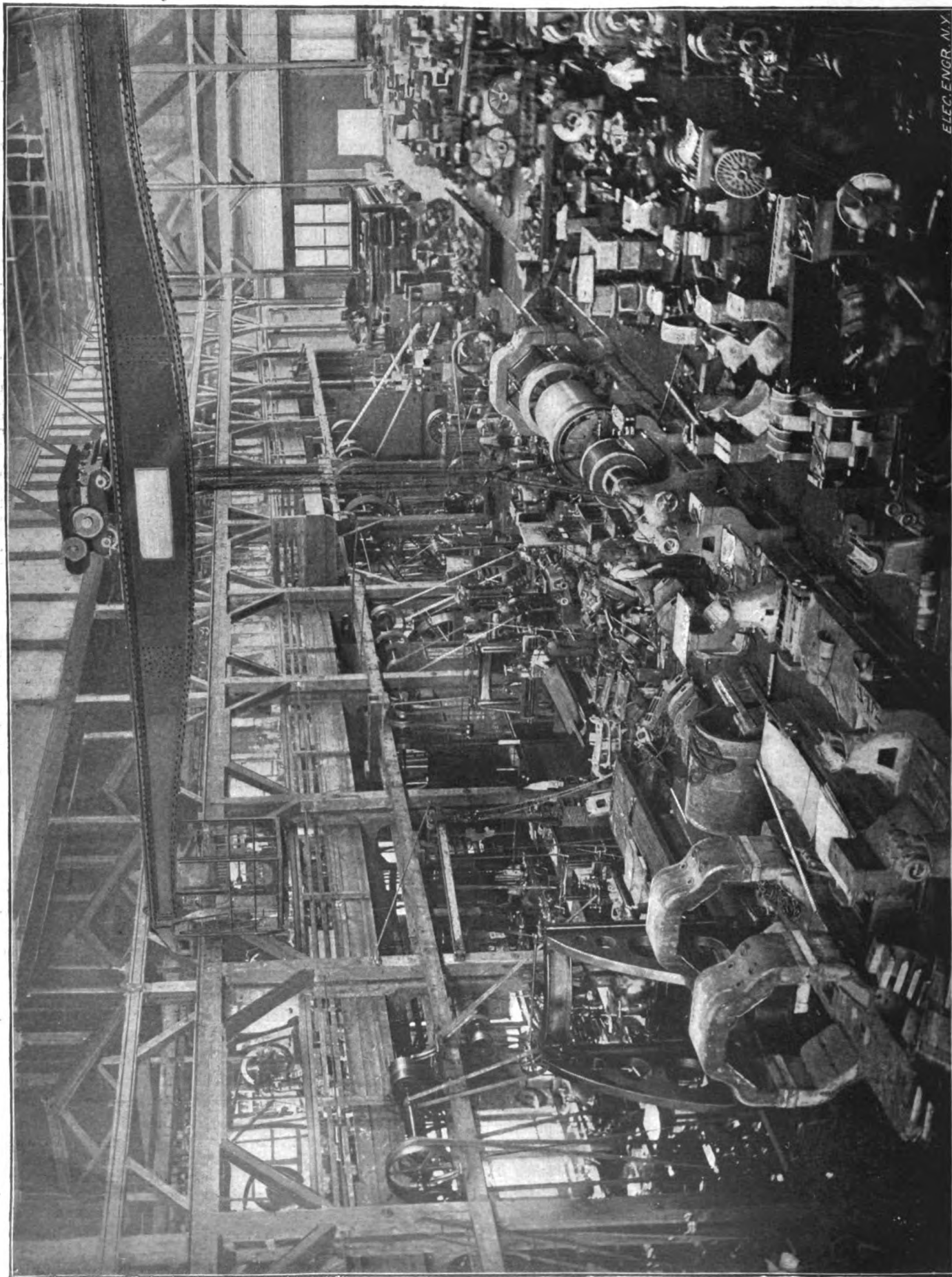
"Now a claim for combination carries with it an implication that the separate elements are old. * * * In the present instance the positive proofs accord with the implication. Most certainly the patent in suit discloses no new means either for transmitting a current of electricity or for equalizing pressure upon the consumption-circuit.

"It is to be noted that the patent leaves it altogether to the judgment of the electrical engineer, or contractor, to determine the relative lengths of the two parts of the combined circuit and the proper thickness of the conductors. As to these points no definite instructions are given. * * * Thus it is left, where indeed it properly belongs, to the intelligence of the electrical engineer to select feeding-conductors of larger or smaller diameter depending upon the comparative cost of copper and of power, or upon some special circumstances." * * *

It concludes its decision as follows:—

"In announcing this conclusion we cannot do better than quote some observations of the Supreme Court which apply with great force to this case, as we read the proofs. In *Atlantic Works v. Brady*, 107 U. S. 192, 199, the Court said:—The process of development in manufactures creates a constant demand for new appliances, which the skill of ordinary head-workmen and engineers is generally adequate to devise, and which, indeed, are the natural and proper outgrowth of such development. Each step forward prepares the way for the next, and each is usually taken by spontaneous trials and attempts in a hundred different places. To grant to a single party a monopoly of every slight advance made, except where the exercise of invention, somewhat above ordinary mechanical or engineering skill, is distinctly shown, is unjust in principle and injurious in its consequences." * * *

The trend of recent decisions and dicta in the courts has been to impose salutary limitations on patents supposed to cover whole fields of endeavor and invention, and we must confess that to us such decisions appear eminently right and fair. Even when a great inventor has opened up a new domain, it is not just that his early work should bar or absorb the work of every other meritorious inventor who comes after him for 17 years, and after that, too, by means of the grip obtained on the art. The benefit of the "disclosure" that the inventor makes is not merely the good derived by the buyer of a new thing, but the stimulus afforded to thinking and inventive men to effect at once all the advances and improvements they can. As is well said, each step forward prepares the way for the next, and the real intention of the patent law is to secure to each man simply that which he himself does now, and not what some other man will do ten days or ten years later, in pursuing the onward path. Moreover, in the present instance, the Court denies that the patent in suit embodies any real invention worthy of protection; yet as we all know that patent has been regarded as a powerful weapon of monopoly and exclusion. It will be such no longer.



FLOOR OF MAIN MACHINE SHOP, CANADIAN GENERAL ELECTRIC CO.'S WORKS, PETERBORO, ONT.

ELEC. ENGR. N.Y.

THE DEVELOPMENT OF ELECTRIC MANUFACTURING IN CANADA.

BY

T. C. Martin

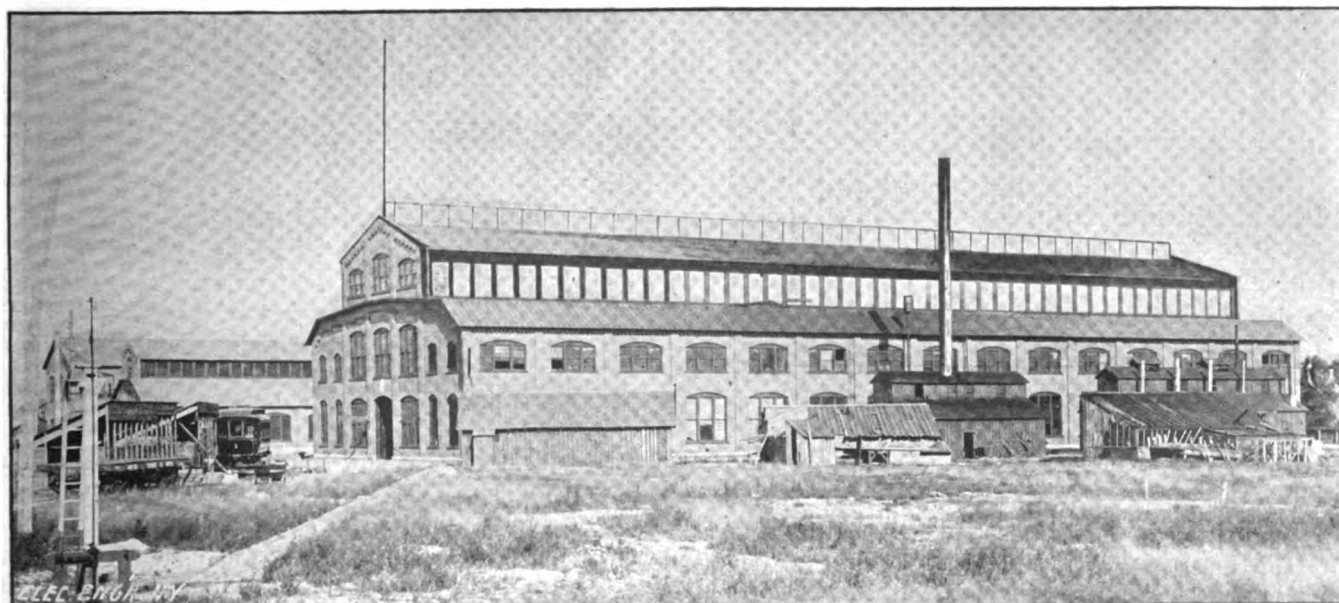
I.
 N a country such as ours, where the passion for the establishment of new industries has been indulged to a remarkable extent, the evidence of a like desire and impulse on the part of Canada should win approval. Indeed, the display by any people of an ambition to excel in manufactures and arts is to be greeted with sympathy, alike by free traders and protectionists. It might truly be said that one of the strongest proofs of a vigorous national pride is to be found in the zest with which the yearning for varied industries is gratified. No discredit is cast upon agriculture or pastoral pursuits by the development of the innumerable handicrafts that contribute to the peace and happiness of civilization; and while it were greatly to be wished that a rural life were more attrac-

tive than it shows itself to-day, the fact remains that the greatest nations of the modern world are those in which population has massed itself together, both to practice and to enjoy the arts, in manufacturing communities.

The situation of Canada in this respect has been a very interesting one. Her growth has not been so rapid as that of the United States nor have the mechanics of Europe

flocked so persistently to her shores, to raise by competition the standard of excellence among the artisans; but her needs have been proportionately as great as ours, the area to be supplied has become enormous, and the national spirit has steadily made her more self-centered and more self-sufficing. Every industry of importance and vital utility has found a home in the Dominion, sometimes under favorable conditions, sometimes under discouraging, but with the main result that were almost all exterior sources of supply cut off, the daily existence of her citizens would run on, with possible shortcoming in one or two details, but on the whole as rich in comfort and conveniences as ever.

The newer an industry is the less likelihood is there of its rapid spread and arrival at prosperity in several distinct locations. It is also one of the commonplaces of commerce that certain trades and articles thrive only in certain spots and will not bear transplantation; but the making of fine poplins in Ireland, of delicate lace in Brussels, of strong ale at Burton-on-Trent, of Sevres ware in France, does not stand in the way of other successes elsewhere; and perhaps it is quite as well that this should be so, for life would be dreary if there were never any choice in food, drinks, clothes and furnitures. It is not difficult to believe that in some future evolution of human affairs everything will be made exclusively at the best spot for its production, and that the managers of the international factories will scorn to be respecters of individual tastes and local idiosyncracies. In the meantime, we must take consolation in the knowledge that the tendency of the hour is rather toward the establishment of new points of production within close range of the nascent markets of consumption and that in every progressive part of the globe the birth of a new in-

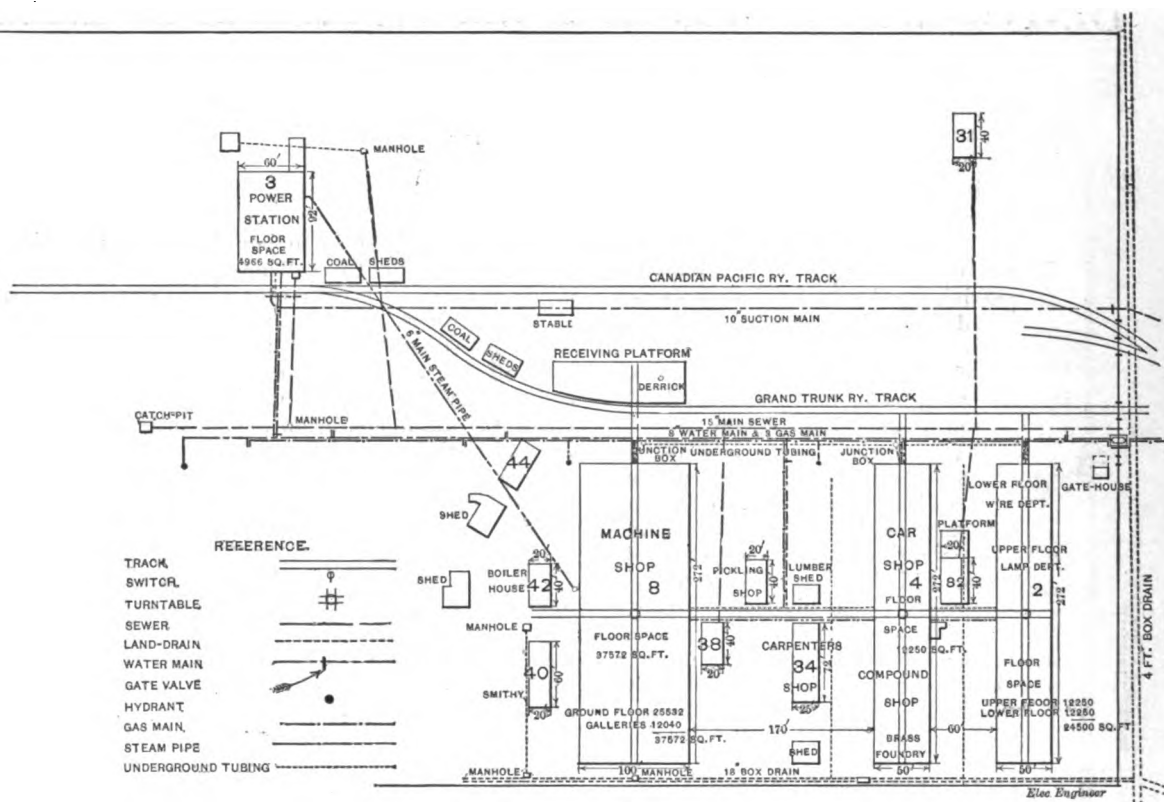


VIEW OF CANADIAN GENERAL ELECTRIC SHOPS FROM THE POWER HOUSE.

dustry of value to mankind creates an opportunity for enterprising capital and another career for brains and labor.

Electrical manufacturing is a distinctly new industry, in the mechanical and engineering sense, if we omit land and

front rank as regards quality and quantity of work. About a year ago, it was the good fortune of the present writer to inspect and describe the electric road along the Canadian shore of the Niagara Falls, and he was then



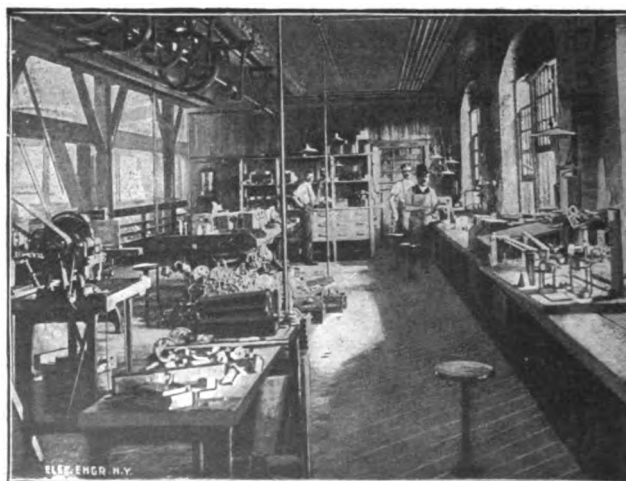
PLAN OF THE CANADIAN GENERAL ELECTRIC CO.'S SHOPS AT PETERBORO, ONT.

ocean telegraphy; and even if we include all that has been done from the date of the quadruplex and the laying of the first Atlantic cable. The early pre-eminence of England and later predominance of the United States, in elec-

greatly surprised to learn that the apparatus for that fine road was practically all of Canadian manufacture. Resolving at that time to visit the factory turning out machinery superior in some respects to that produced on this side of



A GROUP OF ARMATURE WINDERS.



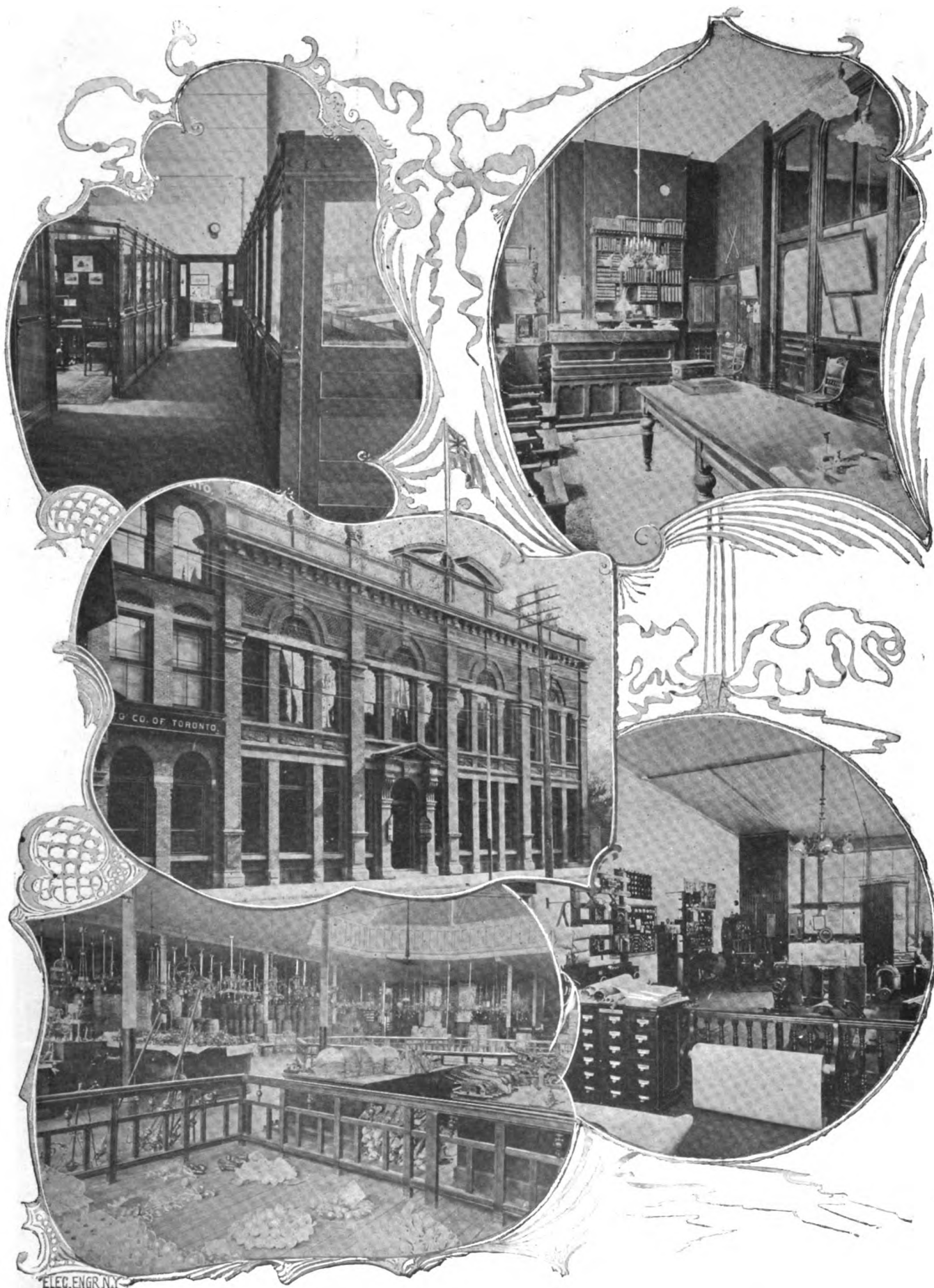
THE THOMSON METER DEPARTMENT.

trical engineering manufactures, is well known, but it has not yet become easy to realize that the young Dominion of Canada, owing perhaps in some degree to its fiscal policy but assuredly in a large degree to its native courage and energy, has already placed itself abreast of England in electrical manufacturing as a branch of industry and is supporting by its own demand for the product a factory that is decidedly in the

the Great Lakes, he has now had the chance to gratify the wish, and proposes to make a few notes of his trip.

II.

The Canadian General Electric Company is one of the largest engineering concerns in the British colonies; it is undoubtedly far larger than any other electrical company



GENERAL OFFICES.

EXTERIOR OF BUILDING.

GENERAL MANAGER'S OFFICE.

SHOW ROOM.

ENGINEERING DEPARTMENT.

HEADQUARTERS OF THE CANADIAN GENERAL ELECTRIC CO., TORONTO.



WINNIPEG EXTERIOR.
MONTREAL EXTERIOR.
HALIFAX EXTERIOR.

WINNIPEG INTERIOR.
VANCOUVER INTERIOR.
VANCOUVER EXTERIOR.

BRANCH OFFICES OF THE CANADIAN GENERAL ELECTRIC CO.

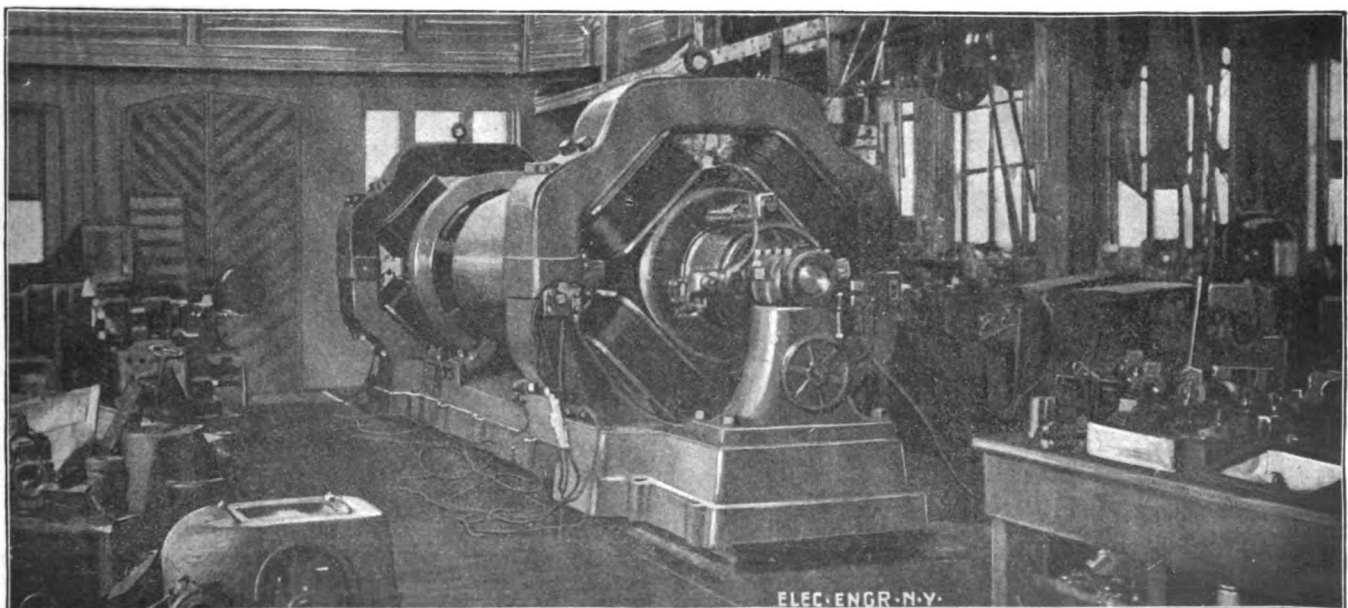


SWINGING THE ARMATURE INTO ONE OF THE MACHINES FOR MONTREAL.

in the colonies, and for variety of product probably has but one equal even in England itself. To some persons it may seem that the variety is not peculiarly commendable, and that greater success might attend a narrower scope of operations. But the truth is that isolated as Canada is on the one side by vast distances and on the other by political barriers, it behooves a company that would take proper care of its market, to make many things in which there is little or no profit, simply for the welfare of its customers, who may want unusual goods at any odd moment, and who would be in dire distress if they often had to wait on transatlantic or transfrontier replenishment with its uncertainties of exact execution of orders. Moreover, the Canadian General Electric Company, besides being of necessity a "universal producer," has by different processes of accretion and business strategy become the owner of all the best things that we on this side have designed or invented electrically, while the natural near relations with England have given it special freedom in other directions, as to obtaining raw material or detail parts that go to the finishing of goods not desirable to produce in their entirety. The Edison patents belong to the Company; so also do many of the Thomson-Houston, as well as some of Prof. Thomson personally, of Mr. J. J. Wood, and of other leading American inventors and parent companies. It is needless

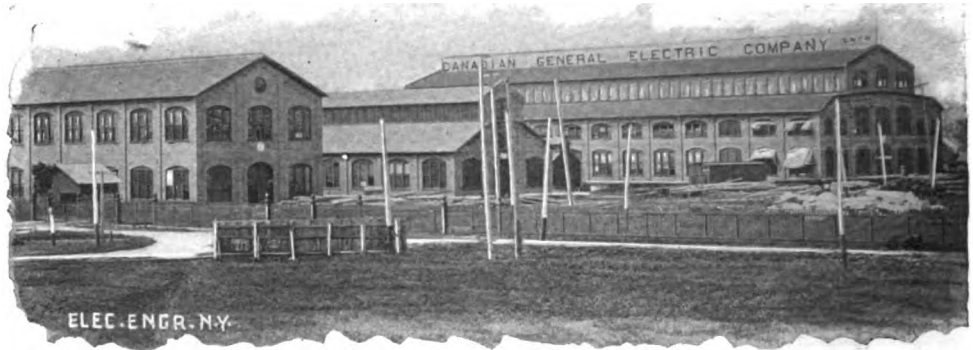
to point out that starting with such a basis, the Canadian General Electric Company as it exists to-day has got into the field very economically and advantageously. With a paid up capital of \$1,500,000 and an authorized issue of \$2,000,000, it is doing a sound, aggressive business and has never been more prosperous than during the recent period of financial disaster in America that has seen our electrical industries of every nature restricted and paralyzed. Its factory at Peterboro, Ontario, when visited by the writer in dull July had between 400 and 500 names on its pay roll and was running 24 hours a day!

The headquarters of the Company are on Front street West, Toronto, and there are branch offices in Montreal, Halifax, Winnipeg and Vancouver; all being illustrated on an adjoining page. The headquarters building is a handsome structure, 90 by 100 feet, and with its two stories and basement affords 25,000 square feet of floor space. It is in direct communication with the Peterboro factory by special telegraph wire, and has direct wires to both the Canadian Pacific and the Great North Western Telegraph Co.'s offices. There are several departments, all in close touch with the General Manager's office, from which all initiative proceeds, and to which all transactions are reported. The Comptroller's Department has charge of all financing, accounting, and collections; the Purchasing Department



ONE OF THE BIG MONTREAL DOUBLE UNITS ASSEMBLING PRIOR TO SHIPMENT.

buys everything required for a most miscellaneous business; the Sales Department attends to the selling and to the filling of all orders; and the Engineering Department, in control of all the technical details, prepares estimates for plants of all kinds and superintends their installation. Beyond these are the local agencies, supplemented by a corps of traveling salesmen. The Halifax Agency has under its care all the Maritime Provinces; the Montreal, all the Province of Quebec; Toronto deals directly with the whole Province of Ontario; Winnipeg is "hustling" all the time to keep pace with the growing needs of the prosperous Province of Manitoba and the gigantic North-



BIRD'S EYE VIEW OF THE WORKS AND GROUNDS OF THE

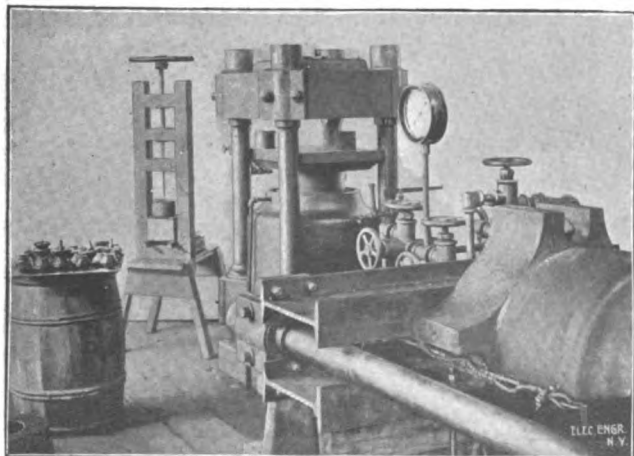
the contract work is shipped from the Peterboro factory. As each has to draw its stock from the Toronto headquarters, it will be seen that the stock there is necessarily very large. Each agency has its own staff, while in Toronto there are over 30 managers, clerks, etc. One or two of our illustrations furnish an idea of the facilities at the different points, and exhibit the company in an alert attitude, ready to take immediate advantage of every new opportunity arising in its vast field of operations.

That Canada should offer a good market of consumption for electrical goods surprises many people who have not



A CORNER OF MAIN MACHINE SHOP GALLERIES.

west Territories; while the Vancouver Agency has the Province of British Columbia to look after, and does not disdain to cast an eye even further westward. The agencies fill the bulk of their orders from stock, but of course

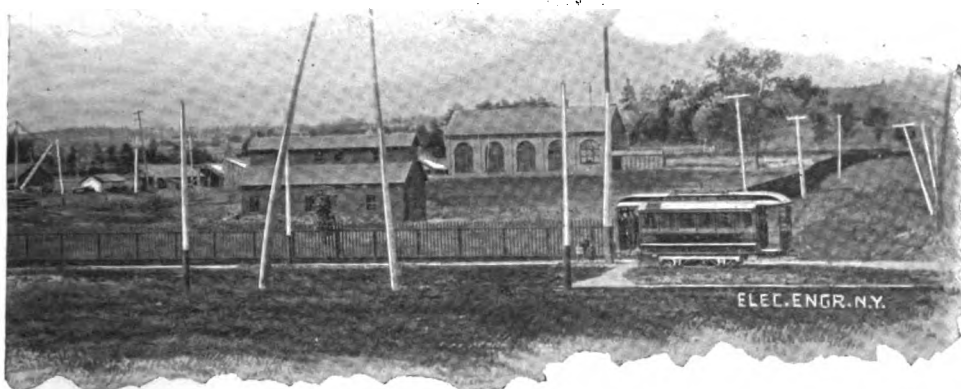


PRESS FOR MAKING LIEBITE INSULATORS.



SWITCHBOARD FOR THE SAULT STE. MARIE CANAL.

studied her physical and social conditions. The truth is that her natural resources are those to which every electrician of note and foresight now turns his thoughts. The water powers of Canada are innumerable and illimitable. At the recent banquet given in Toronto to the Intercolonial Delegates, one of the most striking speeches was that in which an eloquent Australian alluded with pathetic envy to the rushing waters that everywhere in Canada had gladdened the eyes and ears of the visitors from the thirsty, riverless continent at the Antipodes. For many years past, the Dominion has been actively engaged in utilizing by means of electricity some of these inexhaustible stores of energy, for light,

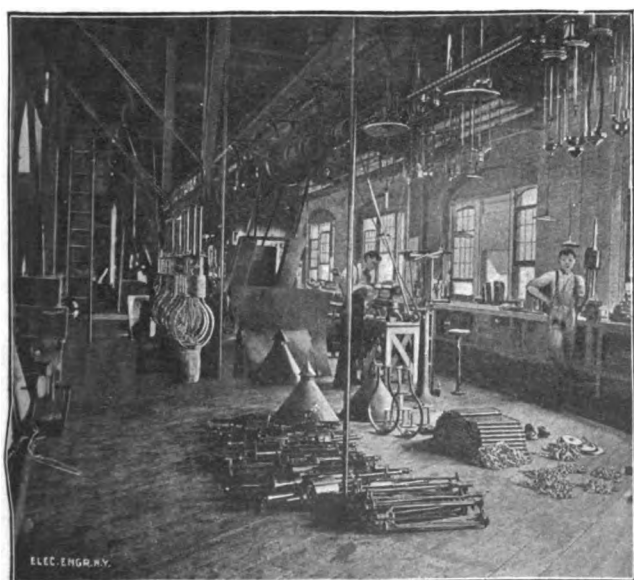


CANADIAN GENERAL ELECTRIC CO., PETERBORO, ONT.

heat and power, but the work has only begun; and as each new lumber mill, mine, town or city comes into being by stream and lake, another plant or station is started. Moreover at both oceans Canada has fine deposits of coal for her provinces there; and even of natural gas she has not been denied a share. Beyond this, while the long nights make an abundance of light highly welcome, the mildness of the climate has invited to the extensive exploitation of electric railways. Some of the earliest successful railway work on the American continent was done in Canada by the late C. J. Van Depoele,² and since that time electric roads have multiplied and prospered, in every direction, from the Bay of Fundy to Puget Sound. The winters have not proved too severe for them; on the contrary, the damper air in the United States has made many experts familiar with both countries prefer to deal with the dry Canadian snow and the better insulation due to the crisper, dryer atmosphere. So, too, with electric heating, the cheapness and prodigal abundance of the water power has made it far more possible in Canada than it has been among us to employ the modern apparatus designed for converting waste into warmth.

III.

The factory in which the Canadian General Electric Co. has now centralized all its productive work is at Peter-



IN THE ARC LAMP DEPARTMENT.

boro, Ont. 70 miles from Toronto. For aught the writer knows to the contrary, it might just as well have been

only 7 miles, with equal or greater benefit, but the town is quite favorably known as a manufacturing centre, and the man who owns a Peterboro canoe counts himself discerning and fortunate. The electrical industry has done not a little for the place, which now boasts of being the largest town in the Province, but looks complacently on the recent legislation to make it a city. The fact that the C. G. E. Works employ about 500 hands night and day gives them first place and high esteem in this thriving community of ten or twelve thousand souls, and it is impossible to

approach or leave the place without seeing the handsome buildings within the enclosure of about 40 acres. There are

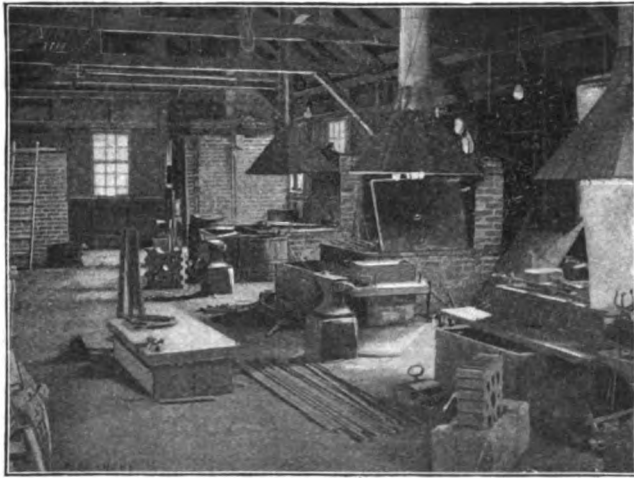


CUTTING UP MICA AND MAKING LAMP HOODS.

nearly 20 separate buildings as set forth in the plan shown on page 228, all reached by track, and all raw material or finished product is delivered or taken away by means of switches to the main tracks of the Canadian Pacific Railway and the Grand Trunk. The four largest buildings, all of brick and stone are the Main Machine Shop, the Tube and Carpentering Shop, the Wire Shop, and the Power House; besides which there are Car Shop, Paint Shop, Smithy, Foundry, Storeroom, and other departments and accessories. The largest buildings referred to above are built on the lines of those at Schenectady³, and are said to be the finest in Ontario. It seems likely. The Main Machine Shop is 272 feet long, 110 feet wide, 60 feet high, with a gallery 25 feet wide on each side. The next shops in line are both 272 feet long, 50 feet wide and two stories high. Outlying the general group is the fine power house, from which current is furnished for about 500 incandescent lights and ten or a dozen arcs, as well as for 10 motors of an aggregate 200 h. p., the shops being operated by electricity. Steam is also laid on for heating, and every facility and convenience is at hand for the comfort of the employees, most of whom live handy to the factory but

2. THE ELECTRICAL ENGINEER, Oct. 18, 1893.

3. See "Edisonia," THE ELECTRICAL ENGINEER, Aug. 12, 1891.



IN THE SMITHY.

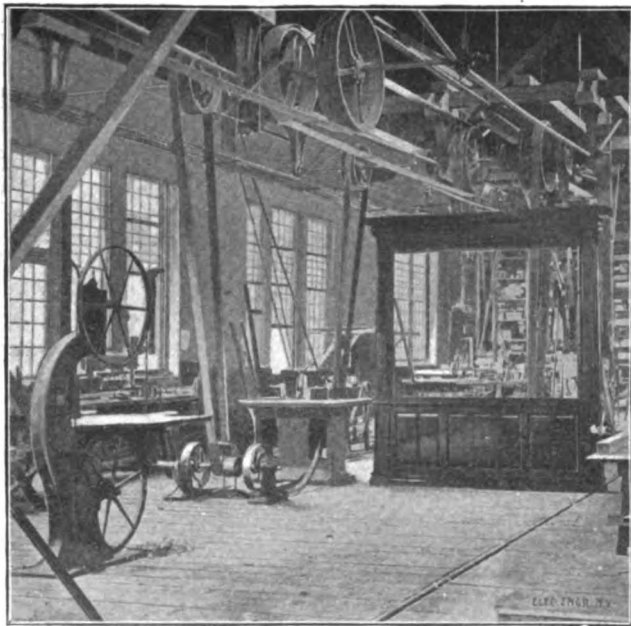


THE FOUNDRY.

who can if they wish take the electric cars at the door and ride home to the other side of the wide spreading town.

IV.

Having viewed the buildings from the exterior and roamed around the yard, through heaps of poles and cross arms, around electric cars awaiting removal and freight trucks full of supplies or ordered goods, we may penetrate to the interior of the main shop, of which one or two comprehensive illustrations are here given. It will be evident

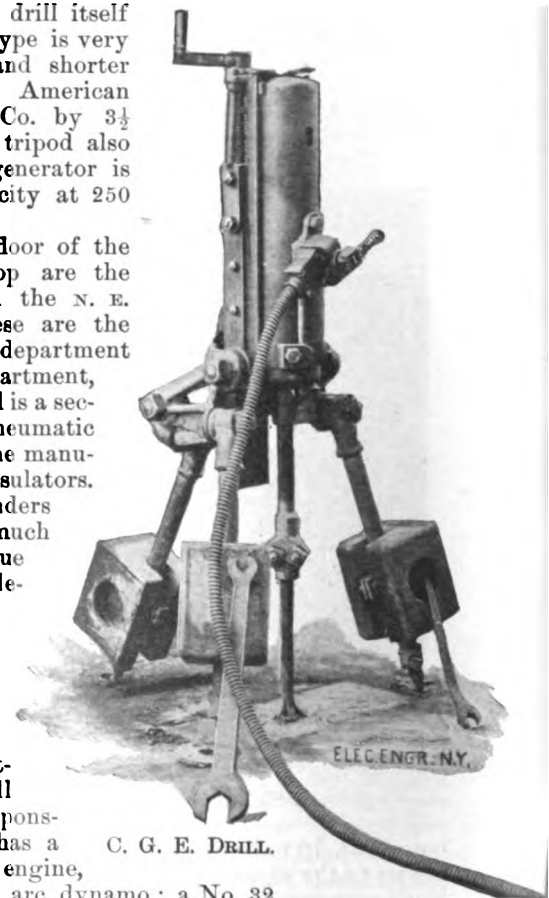


IN THE CARPENTER SHOP.

at a glance that the work done is for magnitude at least, fully on a par with that accomplished in our largest American shops, and more careful and detailed examination brings out many points as to its high grade of finish and excellence. One glimpse reveals, in course of construction, a huge multipolar direct driven incandescent lighting dynamo, of the type built for the Toronto central station, and another gives a good idea of the huge double unit generators, of which 6,000 h. p. has been built or begun for the Montreal electric railway. The incandescent machines are familiar as the Edison Schenectady type, and the railway generators might be called "M. P.'s"

without any loss of identity. But while these colossi first attract attention, it is soon seen that right and left of them are many other machines in rapid process of construction; here some admirable Wood arc dynamos; there some sturdy Edison bi-polars; nearby a well-built welding outfit; or, yonder, a big alternator, an electric drill generator and a mine motor. Some of the apparatus is of unusual interest. The drill outfit, for example, here shown, has been built for work on the Sault Ste. Marie Canal, where more lately the company has furnished electric motors, etc., for handling the locks. The pulsatory current drill generator is very compact, of 12 k. w. capacity, and the drill is driven by it at 380 strokes per minute, drilling at the rate of 100 feet a day, in red sandstone, a 2½ inch hole. Such work seems to take us a long way on the difficult path of electric drilling, in which so many disappointments have hitherto been encountered. The drill itself of the percussion type is very simple and light and shorter than that of the American General Electric Co. by 3½ inches; while the tripod also sits lower. The generator is of 50 ampere capacity at 250 volts.

On the ground floor of the main machine shop are the executive offices in the N. E. corner. Near these are the armature winding department and the testing department, while at the far end is a section with a large pneumatic press, devoted to the manufacture of Liebite insulators. The armature winders have none too much room—a remark true of well-nigh every department—but all the work on this floor is greatly facilitated by the Morgan electric traveling crane. The testing department is very well equipped for its responsible duties. It has a 100 h. p. Brown engine, an Edison (Sperry) arc dynamo; a No. 32



C. G. E. DRILL.



INCANDESCENT LAMPS UNDER TEST AFTER ASSEMBLING.

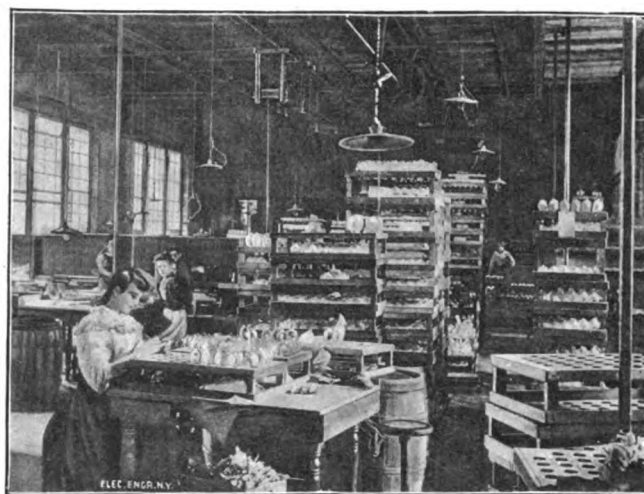
dynamo, 500 volts; a 750 light Edison alternator with laminated field (quite unknown in the United States); a No. 8 dynamo driven by street railway motors under test; a small Ball arc machine; several motors; a number of Kreusi coils for dynamo and transformer testing; two Thomson galvanometers and a Deprez, in iron shields; Siemens dynamometer; Thomson balances; Weston standard voltmeter and portable instruments; a static voltmeter, and coil giving up to as high as 10,000 volts; a number of small testing voltmeters; racks for arc lamps, and other appurtenances. Everything that goes out finds its way hither for rigorous test. Machines and instruments about to be shipped, as many of these are, thousands of miles, need to be about as good as skillful brains and hands can make them. Inexperienced workmen, often, are to manipulate them, and what carelessness or unfamiliarity cannot spoil, lightning will have its fling at.

Many little points call for attention, as one wanders

around, and could be dwelt on at length if space permitted. The Wood arc machines seen are mounted on rails instead of the ordinary solid wooden base used in the States. The street car gears have solid webs, are deeper cut, and the pinions have a wider face. In more instances than one would have expected, modifications from the American prototypes have been tried and by no means unsuccessfully. The shop makes all its own tools, except the heaviest, and has a beautiful collection of jigs, etc. The store room carrying supplies has a simple but perfect system of checking in and out.

V.

Ascending to the galleries, we reach a number of minor departments closely allied to those on the floor below. On one side are the Thomson recording wattmeter department; the Wood arc lamp department, and the sections for mica cutting, making lamp hoods, etc. Along the parallel



LABELLING INCANDESCENT LAMPS.

gallery range the lamp socket department, the switchboard assembly, brass working sections, and a variety of detail work such as that on street-car controllers, lamp mechanisms and the like. The production of Thomson wattmeters is quite large. In fact, a Canadian law requires

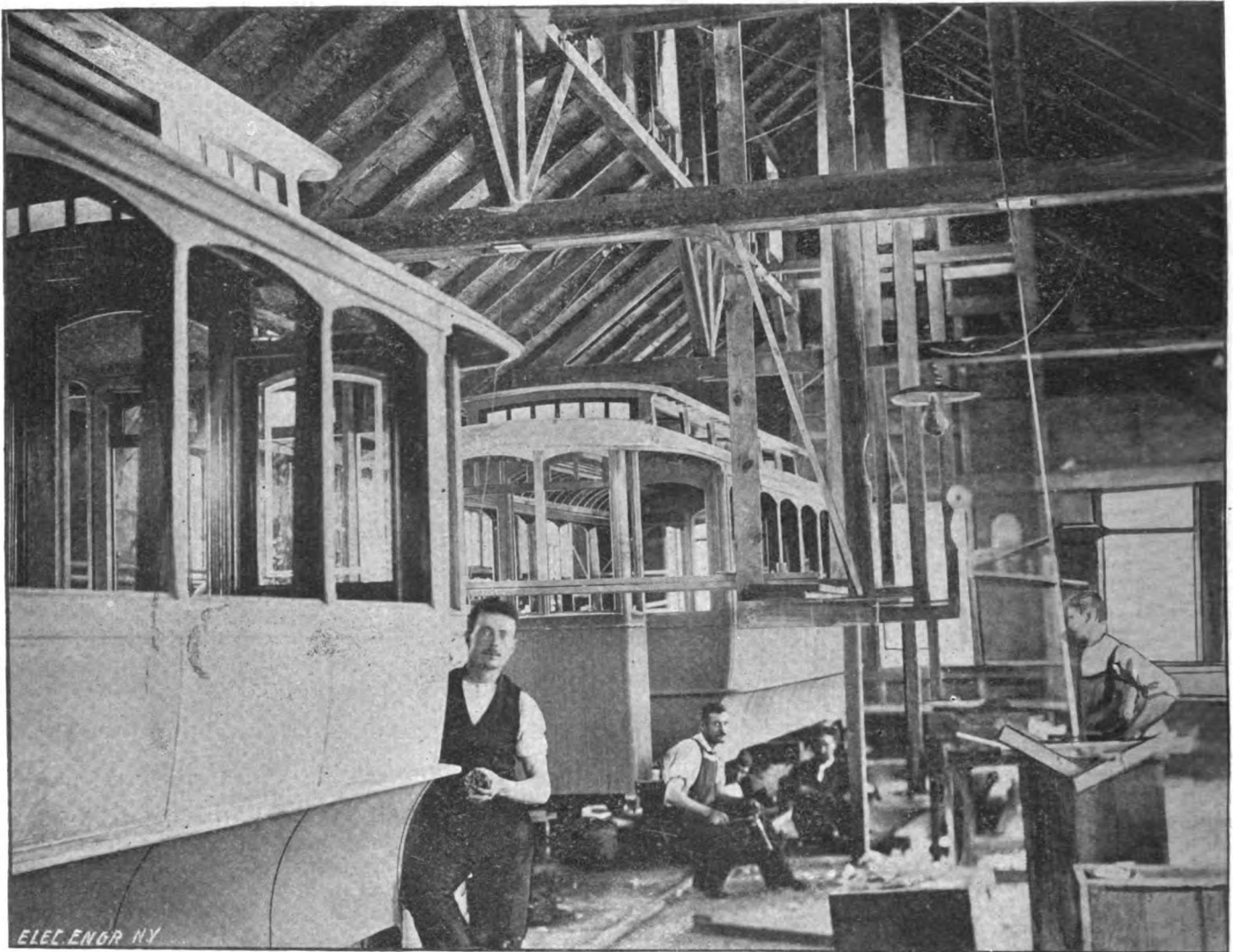


ASSEMBLING DETAILS OF LAMP SOCKETS, GALLERY OF MAIN MACHINE SHOP.

the use of meters that the consumer or owner can read for himself, and now forbids the installation of meters of the electrolytic kind. The Thomson meters are built here for primary circuits, for the two-wire direct and alternating systems, and for three-wire and power work.

afford us illustrations of the higher voltage direct work that has been promised for the near future, and towards which some American manufacturers are now tending.

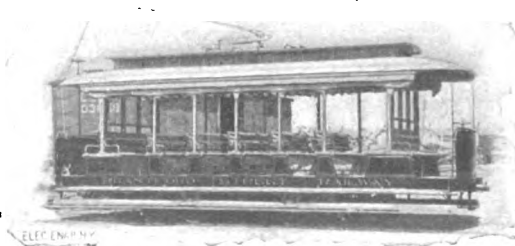
And just here, too, one may indulge in casual speculation as to the greater simplicity or increased complexity of



BUILDING CLOSED CARS, CANADIAN GENERAL ELECTRIC CAR SHOP, PETERBORO, ONT.

Next to this comes the arc lamp department, where lamps of the Wood type are constructed. In the single carbon form, it may be noted, a clutch feed is used in place of the rack and pinion. Another innovation is the employment of a small rod for operating the lower carbon holder so as to recarbon without lowering or taking off the globe. Near by are the benches where hoods are built for the lamps, and racks are handy for speedy testing stage by stage. The double carbon Wood lamps and other details are of wonted construction and are all excellent. It is interesting to note en passant that up to the present the alternating arc has not to any extent made a place for itself in Canada as compared with the direct arc; but what will happen with the growing use of water powers and alternating currents, remains to be seen. It is possible that Canada with her long transmissions may

the lamp socket of the future. As one watches the assembling of so many fine little parts, all fitting so neatly and exactly, it surprises that sockets should be so marvelously cheap as they have become. Yet if reduced some day to the skeletonized proportions of the time honored gas key, they may go lower yet in price; while, on the other hand, if endued with all kinds of regulating functions and made to perform duties of transformation as well, the coming socket may reach an intricate refinement comparable only with that of a watch. Who knows, or who can tell also, what the price will then be? But even then it is safe to assume that the process of putting it together will be much the same as we now see going on here. One of the great curiosities of electrical developments,—to the present writer at least—has been the sudden arrival at a point where the work that needed all the skill, care and

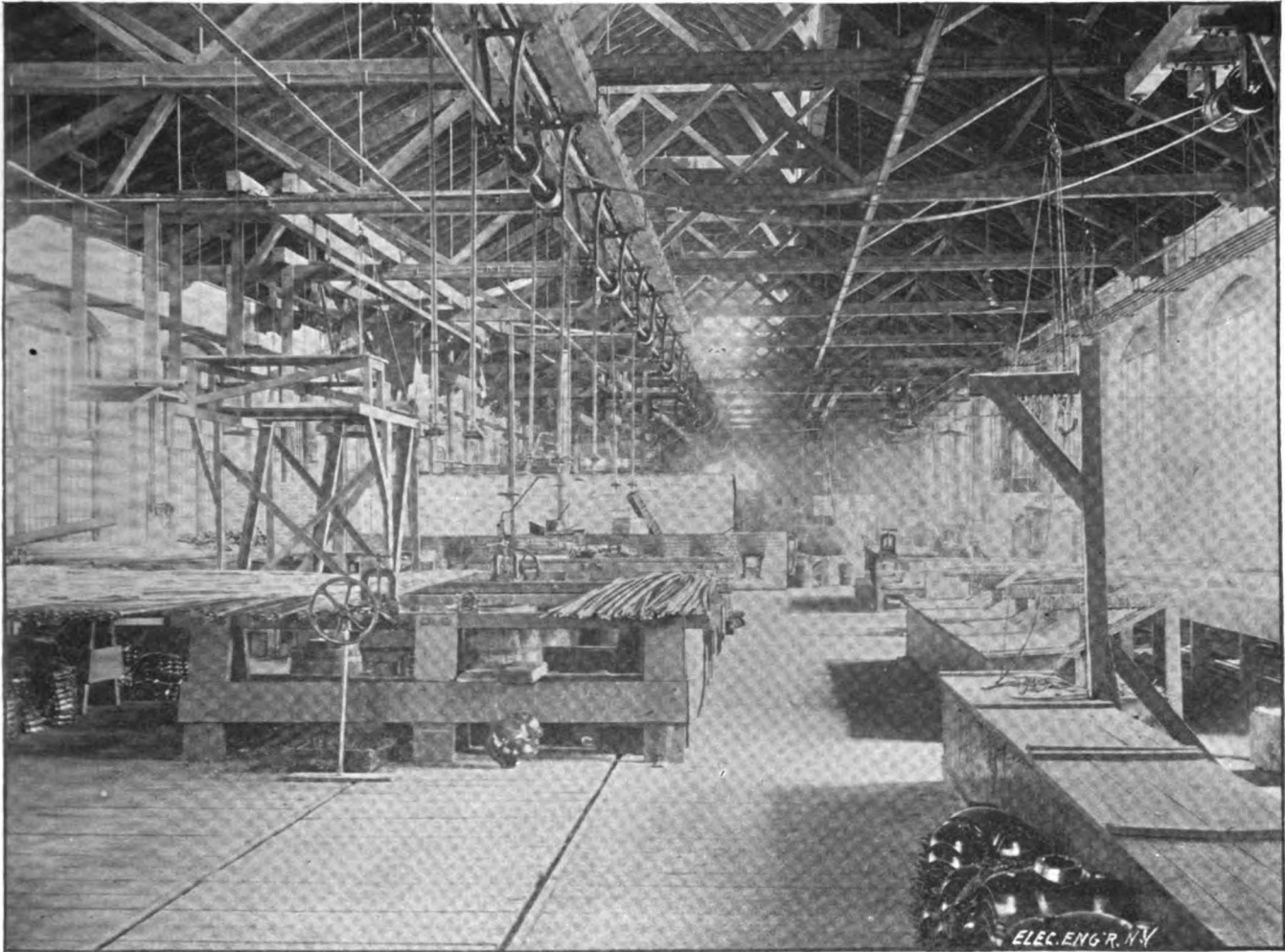


OPEN CAR IN PETERBORO YARD.

intuition of a highly trained expert becomes the easy daily task of a bright boy or intelligent young woman. The first telephones cost tremendous effort; now anybody can make a handful of nails talk like Gabriel's trumpet.

Just beyond the section devoted to socket and cutout production, and amid the busy drills, lathes, turning, spinning and stamping machines at work on brass, we find a handsome switchboard being erected which as a sample of the Canadian General Electric Company's product does it considerable credit. The board is part of an electrical equipment ordered by the Canadian Government for the operation of the Sault Ste. Marie canal locks. It may be mentioned that the company has furnished a pair of motors for each pair of gates and each pair of valves for either side of the

other touches of luxury and comfort. Having just left the fine delicate work of meter and socket construction, it rather startles us to come upon this branch, but the Company is making cars most successfully and has its hands full of orders. Nor does it stop short at these, but builds snow plows and sweepers, or will give you on demand a neat, serviceable watering car or a funeral coach to run over the trolley line that happens to skirt a cemetery. Passing from this busy scene we arrive at the Compound Shop, which has the tube work at one end and the carpentering and pattern work at the other. It is already inadequate to the demands on it, and needs extension. In the carpentry a fine piece of cabinet work had just been turned out at the time of the writer's visit, in the shape of the



COMPOUND SHOP: PREPARING COPPER RODS FOR INSULATION IN IRON TUBES.

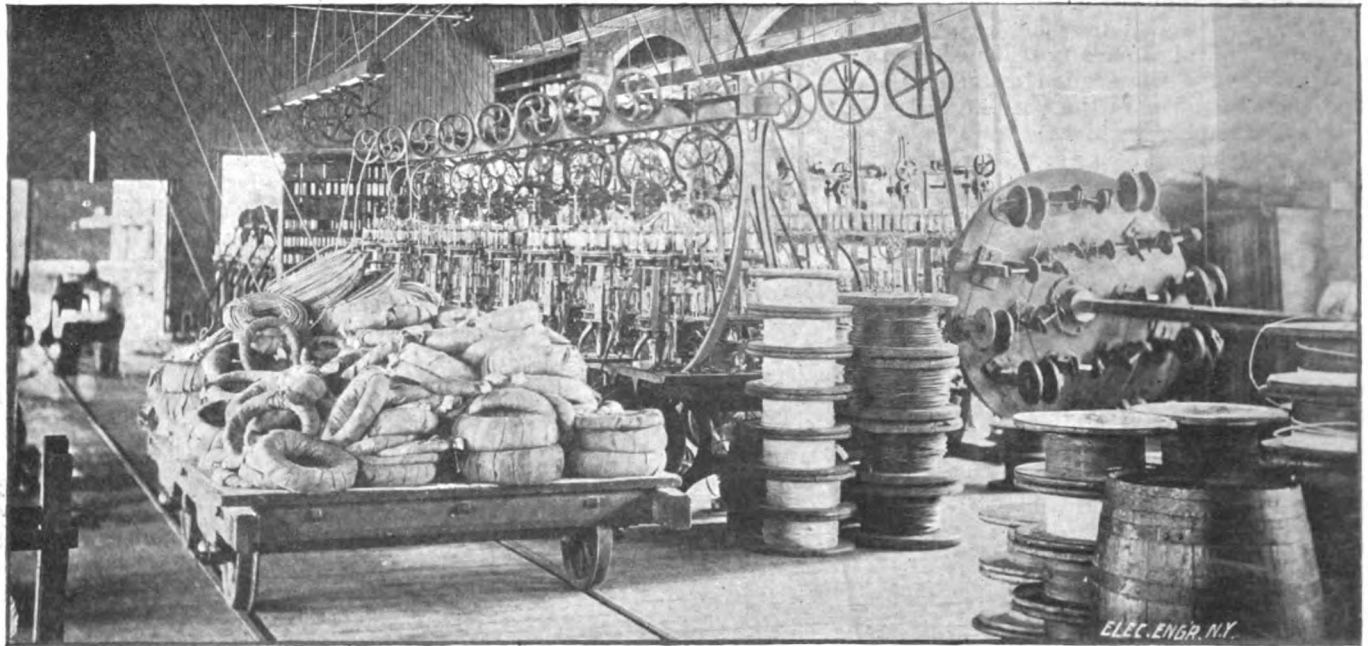
canal. Such a plant is of peculiar interest in view of the growing application of electricity to canals, and the Dominion does not lag behind in this novel utilization.

VI.

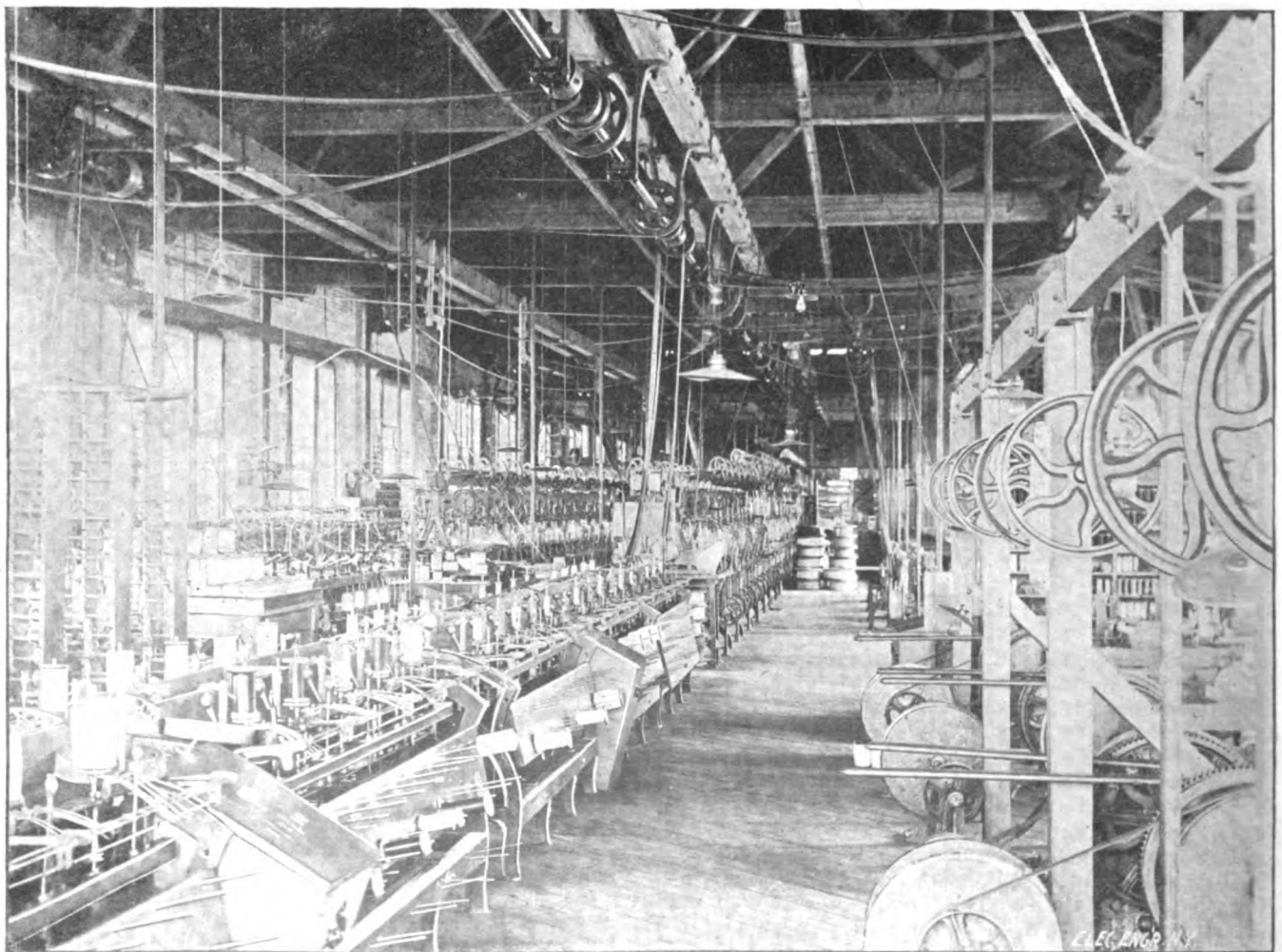
Between the Main Machine Shop and the correspondingly large buildings given up to tube work and known as the Compound shop, are two smaller buildings, one of which is, however, becoming very important. One of these intermediate places is the Paint Shop, and adjoining it is the Car Shop, where the Company is building some remarkably fine street cars, both open and closed. A sample of the open car is shown in the picture of one of those furnished for Brantford, Ont., while the view of the shop shows two or three closed cars in active construction, with extra large vestibules, cut glass doors, skylights of cathedral glass and

elaborate frame for the Sault Ste. Marie Canal switchboard; while not far off was a huge and growing collection of the big electrical patterns that so oddly suggest Egyptian mummies as they lie face up on their shelves, rather than the mighty machines modeled after them, alive with the lightnings of our Nineteenth Century. As for the tube department, it may seem remarkable that underground work should be so far advanced in Canada as this shop indicates, but it is the fact that the objection to overhead wires is encountered there as well as here, with the result that in such cities as Toronto, the Edison tubes ramify in every direction. Back of the tube department is a brass foundry; nor must the smithy go without note.

Our advance carries us now into the third large main building, known as the Wire Shop, but which at present includes the new lamp department recently removed



A DAY'S WIRE ORDERS GETTING READY FOR SHIPMENT.



INSULATING AND BRAIDING DEPARTMENT: WIRE SHOP.



WIRE CLOSETS.

hither in order to concentrate all the manufacturing under one executive control. The wire department, as the carload of orders just being shipped demonstrates, is a brisk and busy place. The lower floor is occupied at one end by the store rooms chiefly, but there are some big stranders and braiders around, wherever a roomy corner permits. At the other end is a spacious vulcanizing department. The Tube Department we have just left

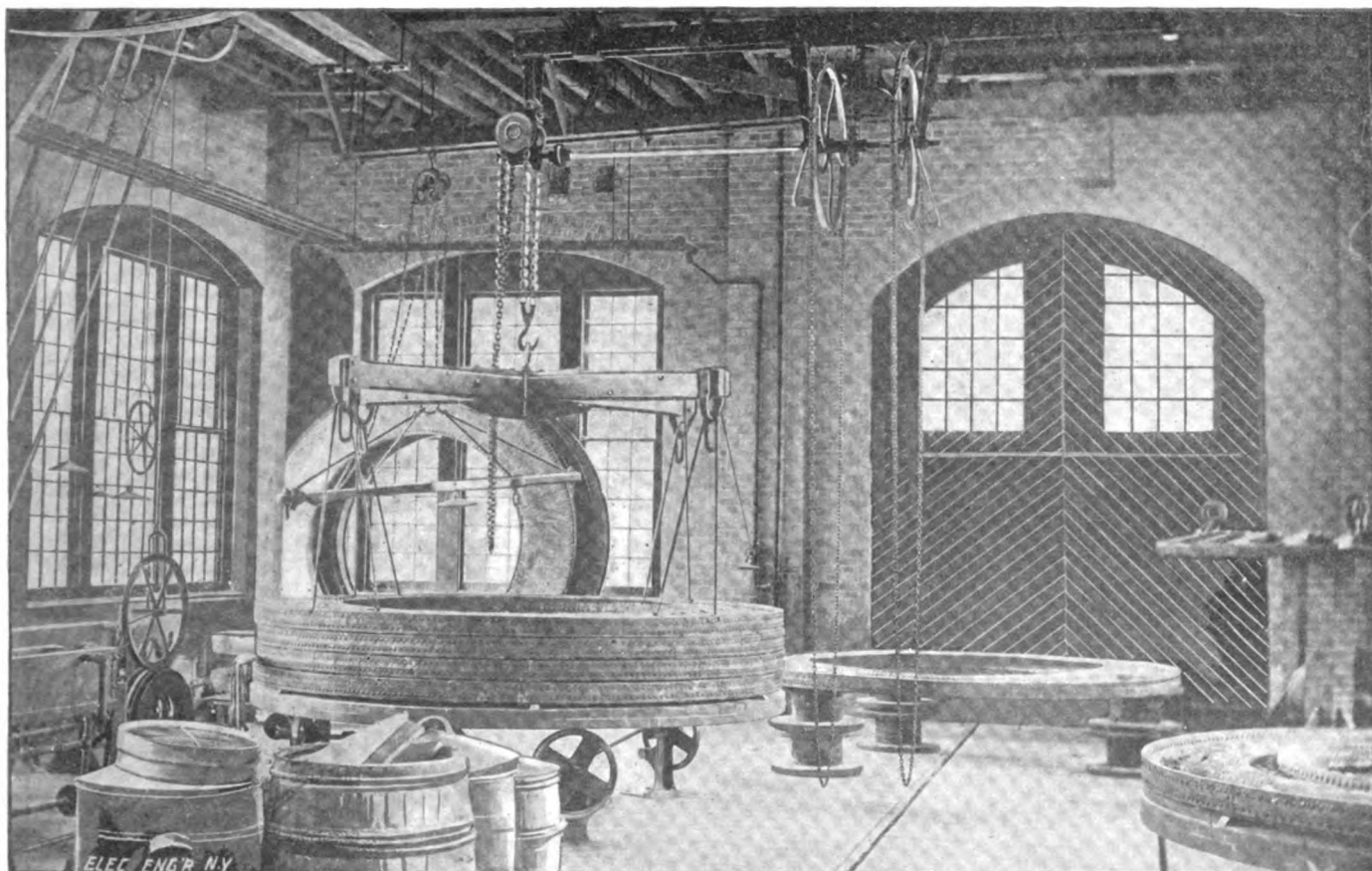
represents, of course, the massive outdoor work, with heavy conductors shielded by iron pipe and running through street and sidewalk; here, on the contrary, we see the not less extensive preparation for indoor wiring and for various classes of overhead wire and cable. Upstairs on the wide and airy second floor, are long rows of all manner of braiding and covering machines for No. 40 wire and upwards, running at high velocities and insulating wire enough, one would think, to supply at least eight quarters of the globe. Where does all the wire go? Is it like pins? This floor is reached not only by stairs but by a strong electric elevator capable of sustaining heavy loads of wire.

The rear of this floor is occupied by a very busy and very crowded lamp factory, of which a few glimpses are taken by the visitor curious to see how the bamboo is split up and carbonized and how the bulb and filament are brought together, pumped out, tested, marked and packed for shipment. Here as in the United States, woman's labor is found efficient and is largely availed of.

VII.

All this vast factory and all the many processes at which we have glanced need power, and the generating plant at Peterboro is well equipped. It comprises two 100 h. p. Edison generators driven by a vertical Edison engine of 200 h. p.; and an Ide engine of 50 h. p. driving a generator of like capacity. The boiler room contains an outfit of 250 h. p. of English Galloway boilers. This plant is hardly equal to the rapidly increasing demands on it, and the company proposes to carry out soon a scheme of phase transmission that will enable it to utilize distant but convenient water power.

Speaking of the boilers recalls the fact that the company has a well established students' course in electrical engineering at these Works; and the pupils go right through,



WIRE SHOP: THE VULCANIZING DEPARTMENT.



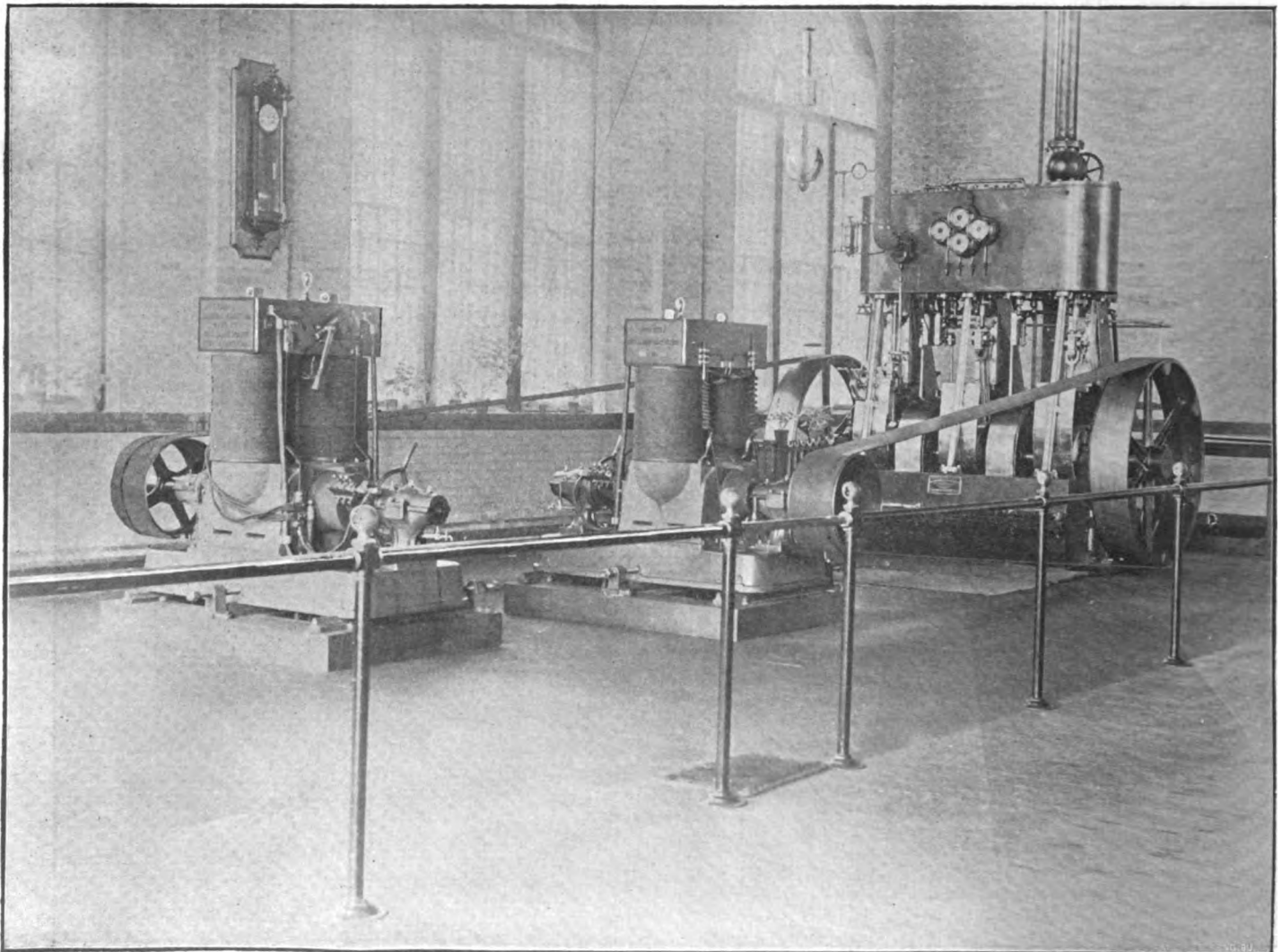
POWER HOUSE, C. G. E. Co.

none of them thinking his course complete unless, as the beginning, he can exhibit a photograph of himself after a morning spent inside the boilers; and, as a finale, another photograph of himself at the controller of the first car over

a road that he has built and equipped. The students pay a small premium and after the first term of six months go on the payroll.

VIII.

Few factories touch so wide a range of work as this, for as will be seen, exact clockwork meters and smallest incandescent lamps and finest insulated wires are made here as well as big street cars, dynamos, and electric railway motors and generators—all under practically the same roof, all subject to the same management and direction. The Canadians have no need to be ashamed of their leading electrical manufacturing industry which in this manner covers several branches pursued separately in some other countries, and which thus puts itself in a position to fill the special conditions prevailing in the Dominion, where a great variety of distinct industries in this field would hardly be possible, and if possible, hardly profitable. As to the work done by the Canadian General Electric Company, it will suffice to name just a few installations, viz.: The beautiful electric road, double track, 13 miles along, around Niagara; the Government power and lighting plant at the Sault Ste. Marie Canal; the 6,000 h. p. generating plant for the Montreal electric street railway; 3,000 h. p. of generators for the Toronto street railway, and some "C. G. E. 800" motors now in course of construction; the station of the Toronto Incandescent Light Co., 40,000 light capacity, including one set of 400 k. w. direct driven multipolar generators; electric railway equipments at Kingston, Peterboro, Brantford, St. Catharine's,



INTERIOR OF THE POWER HOUSE.

Windsor and Port Arthur, in Ontario; Winnipeg, Manitoba; Victoria, Vancouver and New Westminster, British Columbia; three mining locomotives for the famous coal mines at Nanaimo, B. C.; and a large number of lighting plants running from 300 to 6,000 lights throughout the country. Perhaps as good a way as any of seeing the company's work is to travel over the C. P. R. and stop off at every sizable place.

In conclusion it is decidedly worthy of note that the financial interest in the Canadian General Electric Co. is domestic, thus constituting a strong element in its ability to attract and hold business. The directors are: W. R. Brock, president, director of the Toronto General Trusts Co. and the British Canadian Loan and Investment Co.; H. P. Dwight, first vice-president, president Great North-western Telegraph Co. and director Toronto Incandescent Light Co.; Frederic Nicholls, second vice-president and general manager, director of the Manufacturers' Life Insurance Co. and the Toronto Incandescent Light Co.; W. D. Matthews, director of the Canadian Pacific Railway and the Dominion Bank of Canada; George A. Cox, president Bank of Commerce and director of the Canada Life Assurance Co.; Robert Jaffray, president Toronto Real Estate Investment Co., vice-president, The Land Security Co.; Hugh Ryan, director of the Imperial Bank of Canada and the Trusts Corporation of Ontario; J. K. Kerr, Q. C., vice-president North American Life Insurance Co. and director British Canadian Loan and Investment Co. It does not need great familiarity with Canadian affairs on the large scale to recognize these names as associated with all that is at once most solid, conservative and intelligently progressive in the Dominion. Under such auspices the company naturally enjoys in a remarkable degree the public esteem and favor.

PROTECTION FROM LIGHTNING.—IV.

BY ALEXANDER MCADIE, U. S. WEATHER BUREAU.

(Concluded.)

A practical application of the efficiency of lightning conductors will now be considered. On June 5, 1885, the Washington Monument, at Washington, D. C., at that time the highest edifice in the world, was struck by lightning.

Col. Casey, U. S. Army, the engineer in charge of the construction of the monument, requested Profs. Rowland, Newcomb, and Mendenhall to examine the part struck and suggest what precautions should be taken to ensure the safety of the monument. It is proper to remark that the monument had been for all practical purposes finished and had already experienced storms of seemingly greater violence.

From the letter of the commissioners charged with the completion of the monument, we find that "a considerable amount of unexpected work" was performed in the erection of rods and points to protect the obelisk from lightning. "The lightning protectors as established for the monument were commenced in January, 1880, and were finished in January, 1885," practically the date of completion of the monument. The elevation of the solid aluminum pyramid (which weighs 100 ounces and is 8.9 inches high and 5.6 inches square at the base, with angle at the vertex of $34^{\circ} 48'$) is 555 feet (169.16 meters).

The conductors consist of the four hollow wrought-iron Phoenix columns, supporting the elevator machinery. "The bottoms of these four columns rest upon and are bolted to cast-iron shoes, standing upon the floor of the large drum pit, * * * and the shoes are connected to $\frac{3}{4}$ -inch soft copper rods, led to the bottom of a well in the centre of the foundation. This well is 32 feet 10 inches in depth below the bottom of the drum pit and 15 feet 8 inches below the bottom of the masonry foundation, and the water stands in it permanently 2 feet 8 inches above its bottom. After the copper rods were inserted the well was filled up with clean sharp sand for a depth of 15 feet 8 inches, or up to the level of the bottom of the old rubblestone foundation of the monument. These four columns so arranged at their bases, and always projecting above the top of the shaft, were continually lengthened as the building of the shaft progressed, and for the five summers during which the masonry was in progress acted as the lightning conductors of the edifice. No disruptive discharge of electricity was experienced during those years." When the marble pyramidion was completed, December, 1884, these four columns were within this marble covering, and from the extremity of each column a copper rod $\frac{3}{4}$ inch in diameter was run to the top stone and there united in a copper rod $1\frac{1}{2}$ inches in thickness, which

passed vertically through the cap stone and was screwed into the solid aluminum pyramid.

The conductors "when tested, gave an electrical resistance of .1 ohm from the tip of the terminal to the copper rods at the base, and 2.3 ohms for the ground connections, making a total resistance of 2.3 ohms for the conductor. The system was entirely completed and connected on January 20, 1885."

On April 5, 1885, during the passage of a heavy thundercloud over the monument, at least five immense sparks or bolts of electrical light were seen within a period of twenty minutes to flash between the terminals and the cloud without audible sound to the observers. A careful examination of the conductors and shaft after this phenomena failed to reveal any effects from these discharges.

On June 5, however, during the thunderstorm described above, a disruptive discharge was seen to pass between the summit of the pyramidion and the cloud. Upon examining the structure a crack was discovered in the stone on the north face of the pyramidion just under the top stone, extending through the block in a line nearly parallel to the northeast corner and about $8\frac{1}{4}$ inches from it. The fragment was pressed outward about $\frac{3}{4}$ inch at its bottom, chipping a small piece off the lower corner of the top stone into which it was locked, and was easily forced back to place and bolted to the solid stone from which it had been torn.

The recommendations of the gentlemen above named, who were asked to make a careful examination, were, in short, that the interior conductors should be connected "with a system of rods and a greater number of points, to be located upon the exterior of the pyramidion." Four $\frac{1}{2}$ -inch copper rods were fastened by a band to the aluminum terminal and led down the corners to the base of the pyramidion, and then through the masonry to the columns.

"As these exterior rods are each over 60 feet long, they are also connected at two intermediate points of their lengths with the iron columns by means of copper rods $\frac{1}{2}$ and $\frac{3}{4}$ inch in diameter, respectively, furnishing 16 rods in all, connecting the exterior system of conductors with the interior conducting columns. Where the exterior rods upon the corners cross the 11 highest horizontal joints of the masonry of the pyramidion they are connected to each other all around by other copper rods sunk into those joints. All of these exterior rods, couplings, and fittings are gold plated, and are studded at every 5 feet of their lengths with copper points 8 inches in length, gold plated and tipped with platinum. There are 200 of these points in all."

Eight years have now passed since the alterations were made and the monument stands uninjured. Unquestionably, standing as it does, 555 feet high, in the centre of flat, well-watered ground, it constitutes a most dangerous exposure for lightning flashes. No better illustration of the value of lightning conductors can be asked.

LETTERS TO THE EDITOR.

IRON WIRES IN ARMATURES.

THE question recently brought under discussion by Mr. Gilbert Wilkes, in regard to the use of iron wire for the armature and field windings of electrical machines, is certainly one of prime importance to the designer, and one, it seems to the writer, that should at once be settled. As shown by Prof. Anthony in your issue of the 5th inst. the idea is by no means new. The superiority of copper over iron for this purpose has so long been acknowledged that at first thought it seems beyond question.

It is evident that the relative value of the two metals in field windings is dependent to a large extent upon the general design of the machine in question. However, it seems to me impossible that any design could be produced in which iron would exceed or even equal copper in economy, owing to the high magnetic reluctance of such an insulated coil and to the relative specific resistances of the two metals.

In regard to the use of iron on armatures, Prof. Anthony very clearly shows its principal defects. There is, however, one objection to its use on ring armatures that I have not seen mentioned. The presence of the iron wires in the interior of the armature ring would allow magnetic lines to pass through them. This would, of course, have the effect of producing an electromotive force counter to the electromotive force of the machine, thus destroying the useful effect of these lines of force.

Mr. Wiener has instituted considerable discussion in regard to what he calls "core-leakage" in toothed armatures. While, aside from theoretical considerations, I have good evidence that this loss does not occur to any appreciable extent in practice, it is easy to see that an iron wound armature would exhibit this defect to a very marked degree whether the armature core were toothed or not.

It would be exceedingly interesting to electrical engineers in general if Mr. Wilkes would give more definite data to sustain his theories.

FRED. BRAINARD COREY.

Boston, Sept. 6, 1894.

LEGAL NOTES.

THE EDISON FEEDER AND MAIN PATENT DECLARED VOID.

EDISON ELECTRIC LIGHT CO. (GENERAL ELECTRIC CO.) vs. WESTINGHOUSE, CHURCH, KERR & CO.

IN March, 1893, Judge Green of the U. S. Circuit Court, sitting at Trenton, N. J., sustained the Edison patent No. 264,642 of Sept. 19, 1882, known as the Feeder and Main patent, in the suit brought by the Edison Electric Light Co. against Westinghouse, Church, Kerr & Co. The case was appealed to the U. S. Circuit Court of Appeals at Philadelphia before Judges Acheson, Dallas and Butler, who on Sept. 11 handed down an opinion, reversing the decision of Judge Green and dismissing the complaint with costs to the Edison Company.

The claims of the patent on which suit was brought are as follows:

"1. A consumption-circuit, in the main conductors of which the drop in tension is not sufficient to vary practically the candle-power of the lamps connected therewith, in combination with feeding-conductors connecting the consumption-circuit with the source of electrical energy, and having no translating devices connected therewith, the drop in tension upon such feeding-conductors not affecting the relative candle-power of the lamps of the consumption-circuit, substantially as set forth."

"2. A consumption-circuit in the main conductors of which there is a definite small drop in tension not sufficient to vary practically the candle-power of the lamps connected therewith, in combination with feeding-conductors connecting the consumption-circuit with the source of electrical energy, and having no translating devices connected therewith, the loss upon such feeding-conductors being greater than upon the main conductors of the consumption-circuit, substantially as set forth."

"3. The combination of a consumption-circuit, in the main conductors of which the drop in tension is not sufficient to vary practically the candle-power of the lamps connected therewith, with a feeding-circuit having no translating devices, and extending from the source of electrical energy to the centre of the consumption-circuit, substantially as set forth."

After quoting the specification, the Court proceeds as follows: "For the proper determination of this case it is essential that the subject-matter of these claims should be clearly understood. This patent does not deal with the complicated general problem of the distribution of electricity and the sub-division of the current for the purpose of domestic illumination. The patent is not for an incandescent lamp, or for a dynamo for generating electricity, or for the arrangement of the lamps in multiple-arc, or for indicating and regulating devices for controlling the current from a central-station, singly or combined. The patent deals with the one particular difficulty of drop in tension or fall of pressure—loss of electromotive force—due to the resistance of the conductors to the electric flow. To remedy the evil effect therefrom the patentee provides special conductors for the transmission of electricity, extending from the generator to the main conductors with which the lamps are connected and from which they are served. The patent is for a specific arrangement and proportioning of the two sets of conductors, which together constitute the complete circuit. * * *

"Plainly, each of these claims is for a single circuit composed of a pair of transmitting-conductors and a pair of distributing-conductors having the specified characteristics, without regard to any other like circuit. The gist of the alleged invention is in the combination and proportioning of the two parts of the circuit and not in the scale of use. * * *

Reviewing the opinion of Judge Green, the Court says:

"The Court construed these several claims as involving the lighting of a 'large territory,' by the use of 'large numbers' of incandescent lamps, and as implying central station regulation whereby variable drop in tension in remote parts of the system may be controlled. But, in our judgment, these limitations are inadmissible. The fact is, pending the application for this patent it was sought to amend the specification and insert a new claim by the introduction of the matter of central-station regulation, but the Patent Office rejected the proposed amendment for the assigned reason that 'it describes and claims an invention not even hinted at in the original specification, nor shown in any of the drawings. * * *

"The specification states that 'in order to maintain practically the same candle-power throughout the system, the main conductors of the consumption circuit or circuits should be so proportioned that the drop in tension upon them shall not exceed a definite small limit—for example, five per cent.'—but gives no information whatever how this is done. This silence is highly significant. The specification assumes that to secure uniformity of electrical pressure, and thus uniformity of effect, is a matter of common knowledge among those skilled in the electrical art, as indeed it was. The drop or fall in tension or pressure in an electrical current in its passage through a conductor was an observed and well understood phenomenon long prior to the year 1880. It was known that its cause was the resistance offered by the conductor to the flow of the current, and the laws governing the flow of electricity and the drop in tension had been ascertained and published, and were perfectly familiar to all skilled electricians. They understood the effect upon the drop in tension of variations in the size

and length of the conductor and of changes in the electromotive force of the generator; and the ascertainment of the proportions to be given to a conductor to secure a definite fall in pressure with a given current, was a mere matter of calculation, to aid which formulae had been worked out."

The Court then cites the fact that in the art of electroplating as practiced long before 1880 there existed an arrangement of circuits substantially the same as that of the patent in suit. It then takes up the Khotinsky French patent of 1875 and holds that "the laws governing the flow and distribution of electricity in conductors were perfectly well known to electricians at the date of Khotinsky's patent, and any electrical engineer of ordinary skill then called on to construct a circuit of Khotinsky's system, it is to be assumed, would have acted in accordance with common electrical knowledge, principles and practice—in other words, he would have made the main conductors of the consumption-circuit sufficiently large to be of practical utility."

"Now it is quite true that prior to the year 1880 electric lighting for ordinary domestic purposes was not an accomplished fact. But this was not for lack of anything shown by the patent in suit. The great desideratum was a practical incandescent lamp. Such a lamp, with a filamental carbon conductor of high resistance and burning with a very small amount of current, was devised in or about the year 1879, and it solved the problem of the practical sub-division of the electric current for incandescent lighting." * * *

"Under the proofs, we cannot assent to the suggestion that the alleged invention here in question supplied a long felt want, or met a difficulty generally recognized in the art as a serious hindrance to the distribution of the electric current." * * *

"It is a great mistake, as the proofs demonstrate, to attribute to the patent in suit the merit of having solved the problem of economically supplying the requisite current for extensive use to circuits covering large areas, portions of which are at great distances from the source of electrical energy. Whatever of economy in copper may result from the plan of the patent is confined altogether to the transmitting conductors, and the cost of copper restricts the use of this system to comparatively narrow limits. The extension of incandescent electric lighting over large areas is really due to subsequent inventions. Conspicuous among the more recent discoveries and improvements which have brought incandescent lighting into extensive and common use is the converter or alternating-current system, whereby the electric current is transmitted from the generating station to a very great distance at an extremely high pressure and is converted at the points of distribution into the low-pressure currents required by the incandescent lamps."

"The multiple-arc, or derived-circuit, system of distribution being confessedly old and the high resistance incandescent lamp having been devised, to provide 'feeding-conductors which extend from the generator or generators to the main conductors of the lamp or consumption-current,' was, it seems to us, an obvious engineering expedient. Then, as already shown, the proper proportioning of the two parts of the combined circuit involved only the exercise of the common knowledge and skill of the electrician. The facts, we think, clearly bring this case within the principles announced by the Supreme Court in the case of *Hollister v. Benedict, etc., Company*, 113 U. S. 59, and in kindred cases. The plan of electric distribution covered by the claims in question is not 'the creative work of that inventive faculty which it was the purpose of the Constitution and patent laws to encourage and reward.' To sustain these claims would be to sanction a monopoly in that which belongs to the public."

"The decree of the court below is reversed, and the cause is remanded, with directions to enter a decree dismissing the bill of complaint, with costs."

EDMUND WETMORE and LEONARD E. CURTIS, Counsel for Appellants.

FREDERIC H. BETTS, Counsel for Appellee.

SOCIETY AND CLUB NOTES.

PENNSYLVANIA STREET RAILWAY ASSOCIATION.

The third annual meeting of this Association was held at Reading, Pa., on Sept. 5. An interesting paper was read by L. H. McIntyre on "Power Stations." The following officers were elected: President, John A. Rigg, of Reading; first vice-president Robert E. Wright of Allentown; second vice-president G. F. Greenwood of Pittsburgh; secretary S. P. Light of Lebanon; and treasurer, W. H. Lanius of York. Various courtesies were extended by the Reading Traction Co.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The 89th meeting of the Institute, will be held at Headquarters, 12 West 31st Street, New York City, on Wednesday, September 19th, at 8 P. M. A paper will be presented by Frederick Bedell, Ph. D., and Carl Kinsley, A. B., M. E., of Ithaca, N. Y., on "A

Study of the Residual Charges of Condensers and their Dependence upon Temperature. As arranged with the authors, this paper will be read by title, but will be open for discussion. A paper will also be presented by Mr. Elmer A. Sperry, of Cleveland, O., on "The Electric Brake in Practice." This paper will be accompanied by practical demonstrations. A meeting of Western members for the reading and discussion of the above papers will be held on the same evening, September 19th, at the Armour Institute, 38rd Street and Armour Avenue, Chicago, Ill. Members of the American Society of Civil Engineers, American Society of Mechanical Engineers, and Western Society of Engineers are especially invited to attend.

NATIONAL ELECTRIC LIGHT ASSOCIATION.

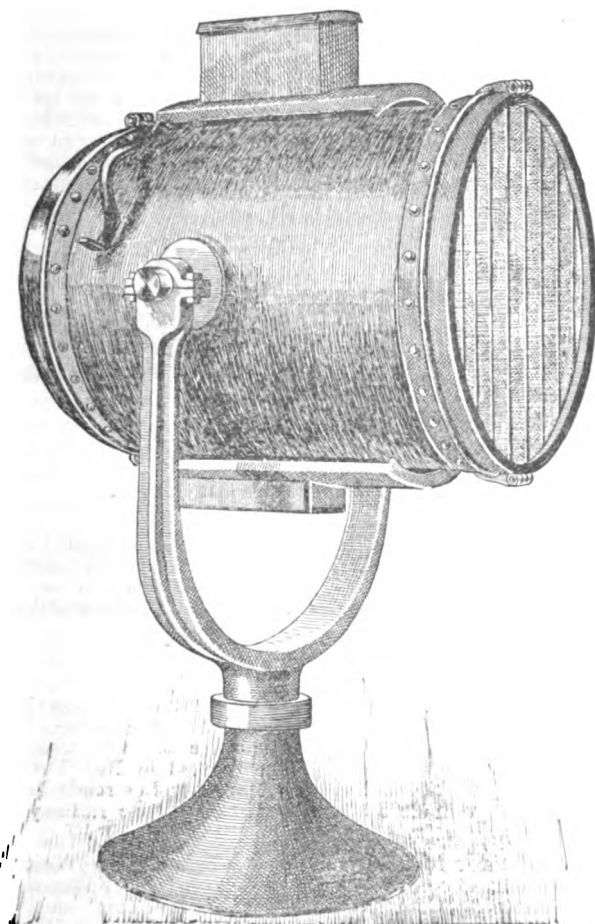
A meeting of the executive committee of the Association was held in this city, at the Hotel Brunswick on September 11, with Mr. M. J. Francisco, president, in the chair. Members of the electrical press were present, in response to an invitation to assist in the deliberations of the committee. It was voted to hold the next convention at Cleveland, O. on Feb. 19, 20 and 21, 1895. An excellent dinner followed the meeting.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

NEW RUSHMORE SEARCH LIGHT.

THE accompanying illustration shows the improved search lamp manufactured by Mr. S. W. Rushmore at his factory in



NEW RUSHMORE SEARCH LIGHT.

Jersey City, N. J. The lamp shown is one of a complete line that he is building for all classes of service, and is the type used mostly for river and inland navigation and as a buoy finder at sea. This type of lamp is made in sizes from five to forty amperes with a glass lens mirror, or in cases where a perfectly straight beam of light is not a necessity, a plain parabolic reflector is furnished.

These lamps are made to operate on any direct current of high or low voltage. The feeding mechanism is of liberal proportions

and the feed is not affected by the position of the light, which will work continuously in a vertical position as when used for flashing signals on the sky when running in fog at night.

This lamp is designed to meet the requirements of a perfect marine light that will not easily get out of order and of such construction that an ordinary mechanic can make repairs when necessary. A desirable feature in this lamp is that it takes full length carbons of twelve and seven inches, insuring long running and economy of carbons. The lamp presents a very handsome appearance and is made of brass or iron, as desired, with copper trimmings.

Other types of this lamp run as high as 200 amperes and have attachments for operating from the pilot house or at a distance from the glare of the light.

ELECTRIC APPLIANCE CO.

THE ELECTRIC APPLIANCE COMPANY wish to take this opportunity to warn their customers against imitations of the Packard lamp which are being offered to the trade by certain concerns with the statement that they are Packard lamps, or just the same as Packard lamps but without the Packard label.

The Packard Company, and the Electric Appliance Company as their Western agents, wish to state positively that unless the lamps are purchased from their authorized agents and bear the Packard trade mark label, they are not the genuine article.

The Electric Appliance Company state that their new Packard transformer type "G" with the combination fuse block for changing the ratio of the windings to make the transformer either 50 and 52 volts or 100 and 104 volts secondary, are pleasing the trade greatly.

VANDEGRIFT'S UNITED STATES TARIFF 1894.

This convenient manual, prepared and published by Messrs. F. B. Vandegrift & Co., Custom House Brokers and Forwarders, of New York and Philadelphia, was found on our table on the very day when the new tariff bill became law. In view of its scope and completeness the enterprise and despatch shown by Messrs. Vandegrift are quite remarkable. In addition to the full text of the Act the manual contains an alphabetical schedule giving the rates of duty with references to Acts of Congress, Revised Statutes and Appraiser's decisions. An extensive Introduction supplies a large amount of information touching Customs regulations, general rules governing importations, Weights and Measures, Money Tables etc., all very useful. Mr. John M. Comstock, Chief of Customs, Treasury Department, commends the book for the fulness and accuracy of its compilation and especially mentions the completeness of its citations from decisions and authorities.

THE HARRISBURG IDE ENGINE ART PORTFOLIO.

The Harrisburg Foundry & Machine Works, of Harrisburg, Pa., have just issued a very tasteful and effective art portfolio illustrative of their work in the field of electric light and power. Each type of engine is illustrated by a separate half tone cut, which is printed on a separate sheet, 9 x 12, with a mat in brown ink, on which is given the name of the engine and a little vignette showing the plant in which each engine is used. Each sheet is stamped in the corner with a shell bearing the name of the works, with a coat of arms. The whole thing is so dainty and pretty that one feels like framing the lot right off. Over 1,500 of the Harrisburg Ide and Ideal engines are in use, making an aggregate of about 200,000 h. p., and the company do well to call attention to their product in this way. The portfolio is the production of Bartlett & Co., who exemplify in it their well known artistic ability and judgment.

BRISTOL RECORDING INSTRUMENTS.

THE Bristol Company, formerly the Bristols' Mfg. Co., of Waterbury, Conn., have issued a complete illustrated catalogue of their recording instruments for pressure, temperature and electricity, the last including ampere, volt and wattmeters for direct or alternating current. The very simple mechanism is shown by well executed wood cuts and the descriptions are clear and to the point.

The company will shortly occupy a new factory with increased facilities for manufacture which the growth of business demands.

THE LA ROCHE CATALOGUE.

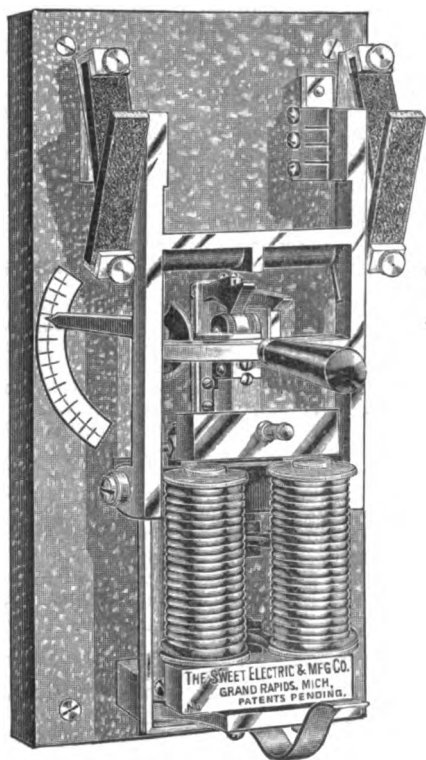
THE La Roche Electric Works, of Philadelphia, have issued their catalogue No. 4 descriptive of their dynamos and motors. The pamphlet is in the form of heavy sheets caught together by a ribbon and presents an attractive appearance. It is profusely illustrated and contains much interesting matter.

THE SWEET LIMIT SWITCH.

THERE has long been a demand for an appliance to take the place of the unreliable fuse wire, as it is a well known fact that the fuse is only relied upon as the last resort in case of accident.

The Sweet limit switch, designed to replace the fuse, is just as positive as an amperemeter. As the amperemeter indicates the volume of current at the point of distribution, so the limit switch, if set to the number of amperes required, will open the circuit of distribution at the predetermined current. The adjustment of the device is controlled inversely as the square of the distance between the armatures and the field piece; so that, mechanically, the pull or work of the switch to open a circuit is practically constant whether 1 or 500 amperes is flowing.

These limit switches are made for use in all pressures—from $\frac{1}{4}$ of one volt to 10,000 volts if required. The circuit is broken in such a manner that when the metal contact is broken the contact is made on carbons which rotate, throwing in a resistance, so that before breaking at the final point of contact, the volume is greatly reduced, and the arc broken rapidly.



THE SWEET LIMIT SWITCH.

The sensitiveness of the machine is very great. It has two coils from which the arms swing above the centres, and the locking and opening device of the machine is attached to a fibre suspension directly attached to the armature with a steel roller which follows over a steel plate cut in such shape that when the armature begins to move and the roller is passing over the projected steel plate the force of the suspended arm increases rapidly, and the unlocking of the lever takes place with this force. As soon as unlatched the rotating carbons, with their outward pressure which is given them by springs attached, make the opening of the machine positive. So positive and delicate in its adjustment is the device that in the larger sizes—200 to 700 amperes capacity—it will open on less than $\frac{1}{4}$ of one ampere above its set capacity, and in the smaller sizes— $\frac{1}{2}$ to 200 amperes—on less than $\frac{1}{10}$ of one ampere.

This switch is adapted to all electrical currents, stationary and isolated plants, stationary motors, dynamos and for house wiring. There is also a special pattern for street car motors.

The Sweet Electric and Mfg. Co., of Grand Rapids, Mich., have started the manufacture and sale of this switch and have already met with flattering success in placing the same on the market.

BERLIN IRON BRIDGE CO.'S WORK.—The Berlin Iron Bridge Co., of East Berlin, Conn., are building a large addition to the machine shops of Henry R. Worthington, at Brooklyn, N. Y. They have also received the contract for an annealing room building for The Naugatuck Malleable Iron Co., at Naugatuck, Conn. The building is 94 ft. wide and 175 ft. long, with brick walls and iron roof trusses covered with corrugated iron.

EFFICIENCY OF MATHER MOTORS.

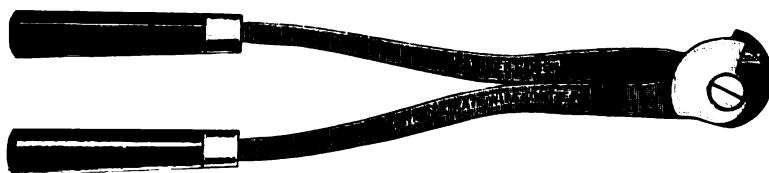
On a recent test made by a prospective purchaser on a three horse power Manchester type motor, built by the Mather Electric Co., of Manchester, Conn., an efficiency of 92 per cent. was obtained. Manufacturers of electric motors generally claim from 80 to 85 per cent. efficiency on their respective motors, and the Mather Electric Co. determined to bend every effort toward turning out a motor that exceed such figures. The design of the well-known Manchester type was followed, and mica insulation was used exclusively. The fields are of cast steel, while the base, sub base, etc., are of cast iron, with the result that the motor is said to be much lighter for the output than any other on the market. The armature shaft is very large in diameter, doing entirely away with "springing of shaft." This motor has been thoroughly tried, and has given great satisfaction. Several large concerns have recently equipped their factories with Mather apparatus. J. Holt Gates, Monadnock Building, is the Western agent.

BALL ENGINES.

THE Chicago office of the Ball Engine Co., of Erie, Pa., in the Rookery Building, has had even in the recent depressing times a fair amount of business. Among sales are: Peninsula Electric Light and Power Co., Houghton, Mich., one 350 H. P. tandem compound engine; Hotel Newcombe, Quincy, Ill., one 60 H. P. engine; Howe Pump and Engine Co., Ladd, Ill., one 50 H. P. engine; Industrial Home of the Blind, Chicago, one 80 H. P. engine, direct connected to General Electric dynamo; Norton Bros., Maywood, Ill., two 150 H. P. cross compound engines.

BRADY'S SAFETY WIRE CUTTER.

THE safety wire cutter with insulated handles, shown in the accompanying illustration, has been introduced by the Brady Mfg. Co., of 83 Washington street, Brooklyn, and was designed by Mr. James Brady, of that company. The cutter is made of steel drop forgings, and has vulcanized fibre handles combining great strength and perfect insulation. The cutter blades are dropped forged, of the best tool steel. All parts are interchangeable, making it always possible to replace broken or worn out parts. The cutter blades are so constructed, that, as they are ground away in sharpening, they can, by a special arrangement, be set



BRADY'S SAFETY WIRE CUTTER.

around one notch at a time, and this can be repeated until the blade is used up, when a new set of blades can be inserted, thus making the cutter as good as new, and this can be repeated indefinitely, as all other parts are practically indestructible.

WESTERN NOTES.

PROF. J. P. BARRETT on his return here was interviewed by the *Chicago Evening Post* and expressed an opinion very favorable to the Johnson-Lundell conduit-storage battery street railway system which he had carefully inspected in New York. Prof. Barrett was one of the first to encourage trolley roads in the west and has kept in close touch with the electric railway business right along.

A CONTRACT for the completed work for the West Chicago Street Railroad contract has been awarded the National Conduit Manufacturing Company, of New York. This contract will amount to about \$75,000. The National Conduit Manufacturing Company feel very much elated over this, as they were brought into direct competition with every style of conduit that is in use to-day.

Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.

Vol. XVIII

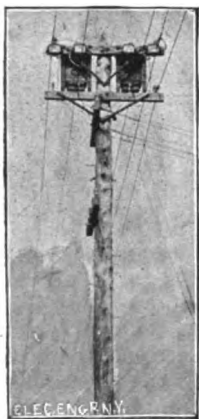
SEPTEMBER 26, 1894.

No. 334.

ELECTRIC LIGHTING BY WATER-POWER AT
PETERBOROUGH, N. H.

BY

Franklin Leonard Pope



THE problem of supplying electric light to the inhabitants of towns of moderate size, say, of 5,000 or less in population, under such conditions as to ensure a reasonable return on the capital actually invested, has been shown by ample experience to be one by no means easy of solution. There are in fact, very few instances on record in which plants of this character have proved to be even moderately profitable; the great majority of them barely earning their working expenses, and some of them not even that, to say nothing of providing for renewals and extensions. In the interior of New England, especially,

such enterprises are severely handicapped by the comparatively high cost of fuel, besides which in most instances, they are worked under additional disadvantages due to unsuitable machinery, defective line construction, and faulty and badly-designed methods of distribution.

The improvements in electrical machinery which have been made within a very few years, especially in alternating apparatus, have in many cases, rendered it commercially practicable to operate small village and town plants by means of available water-powers, even when situated at distances of several miles from the locality to be lighted, and this fact, together with a more intelligent and scientific adaptation of the distribution to accord with local conditions, puts a much more promising face upon the matter at the present time than has heretofore been considered possible.

One of the best examples of a village plant of this character which has come under the observation of the writer, has been in successful operation for a year past in Peterborough, N. H. A brief account of this plant has already appeared in *THE ELECTRICAL ENGINEER*, of Nov. 15, 1893, but a recent visit to the locality has disclosed so many features of interest, that it has been thought that some additional details could not fail to be of value to the profession.

THE TOWN.

Peterborough may be regarded as a typical example of the rural New England manufacturing community. It is a town situated in the southern part of New Hampshire, at the junction of the Contoocook and Nubanusit rivers. These two streams make but little show upon the state map, the latter being, in fact, only about ten miles in length, but within this short distance, it affords an amount of water-power altogether disproportionate to its apparent

dimensions. The principal village lies in a narrow and picturesque valley, closely shut in by high hills. The residence streets radiate in an irregular manner from the business quarter—which is mostly comprised within a length of some thirty rods on one street—and extend for considerable distances up the slopes of the surrounding hills. The industries of the town are quite numerous and diversified, including not only textiles, but various lines of wooden and ivory goods, shoes, thermometers, etc. The population, according to the census of 1890 was 2,507, and it probably is but little, if any, greater at the present time. Peterborough is not, in any sense, a summer resort, but on the contrary, gives one the general impression that most of the money which is spent in the town has been earned there. Some of the factory-owners live in handsome, though by no means extravagant, mansions, but the great majority of the houses in the village are comfortable and attractive cottages of perhaps seven or eight rooms, and are in most cases apparently owned by their occupants. There is a commodious and exceedingly well-kept hotel, usually pretty well filled with transient guests; an excellent public library and reading room, open afternoons and evenings, Sundays



PETERBOROUGH, N. H.; MAIN STREET, SHOWING STREET LIGHTS.
(From a Photograph by F. L. Pope.)

included, and a well-appointed opera-house for public entertainments. On the whole, however, Peterborough is a town which would scarcely impress one as being a particularly favorable field for an electric lighting enterprise, its inhabitants being apparently largely of that thrifty class who know exactly how many cents go to a dollar, and who are much addicted to burning the fragrant kerosene, and going to bed a few minutes after nine o'clock.

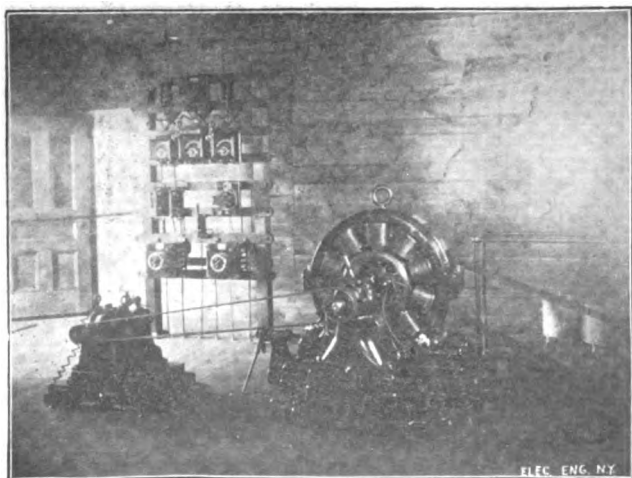
The electric plant is said to be owned by a corporation having but three or four stockholders; one of these being the electrical engineer by whom the plant was designed, and under whose general direction it was installed. The business done is purely that of lighting, as the abundance of water-power in the heart of the village renders the introduction of any other kind of motive power superfluous.

THE WATER-POWER AND POWER-HOUSE.

The water-power which has been utilized for operating the plant is situated on the little river Nubanusit, at a distance of $3\frac{1}{2}$ miles northwesterly from the centre of the village. This stream forms the common outlet of a cluster of half-a-dozen ponds, some of which are of large area, lying in an upland basin at the north-east of the Monadnock range, which discharge their waters through the Nubanusit into the Contoocook, and thence into the Merrimac. Just above the power-station, a low dam sets the water back some two miles, forming a subsidiary reservoir which holds enough water for several nights' run, and incidentally furnishes valuable fishing privileges to the resident electrician. A second dam, a little further down stream, diverts the water into a raceway two or three hundred feet in length, leading to the forebay. The large ponds above contain a supply of water which is ample for the driest season.

The power-station has been partitioned off from one end of a long wooden building, the remainder of which is utilized as heretofore as a saw-mill. The dynamo-room is about 20 feet square, inclusive of the space occupied by a small bedroom for the convenience of the attendant, when compelled, as is sometimes the case, to remain all night. The dynamo is a Thomson 10-pole alternator, having a generating capacity rated at 60 kw. at 2,080 volts and 1,500 revolutions. The exciter is belted to the dynamo and is of the D2 Thomson-Houston type. The dynamo is belted to an 84-inch pulley on a jack-shaft in the basement, making 232 revolutions per minute, which is driven by a Rodney Hunt turbine on a vertical shaft, transmitting its power through bevel-gears, and working under a head of 24 feet. During the day time, the water privilege is utilized by the sawmill, which takes its power by an independent belt from the same jack-shaft. This jack-shaft carries also a fly-wheel weighing about 1,200 lbs., which is found sufficient to give the requisite steadiness to the motion of the machinery. The water-wheel is provided with a Hunt automatic regulator, which appears to perform its duties in a very efficient manner.

The switchboard is furnished with the usual complement of apparatus, comprising a Thomson current-indicator for the main line and another for the exciter



INTERIOR OF THE POWER-HOUSE.

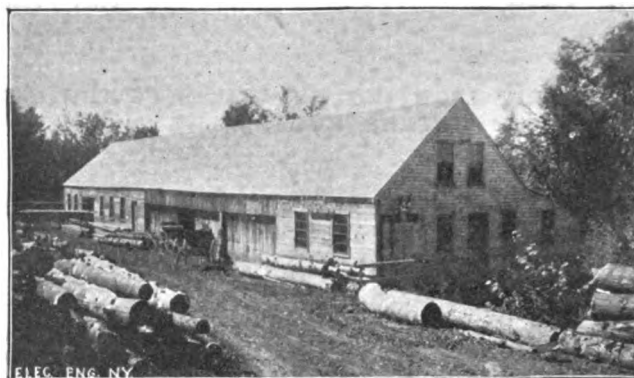
(From a Photograph by Bullard.)

circuit; a potential-indicator for the main line; a ground detector, a 5-light station transformer; rheostats for the fields of the alternator and exciter, etc. All the apparatus was supplied by the General Electric Company.

THE LINE.

The line extends from the station to the town and branches through all the principal streets. It follows most

of the way a main highway, in company with a telegraph and a telephone line, occasionally diverging through the fields to save distance or avoid masses of shade-trees. The poles are of cedar, 25 feet out of the ground; of ample size and well set, at an average interval of about 125 feet. The line wires are of No. 3 Okonite, and are attached to glass insulators with wooden pins, set in a short cross-arm at the top of the pole. Underneath on wooden brackets,



SAW-MILL AND POWER-HOUSE.

(From a Photograph by Bullard.)

are two telephone service-wires of No. 12 steel, belonging to the plant. These are crossed at intervals of ten poles or so, to avoid inductive effects. The drop in potential on the primary is calculated at 10 per cent.

THE DISTRIBUTION.

The general plan of local distribution (shown in the accompanying diagram) is that of triple secondary mains, which are connected at various points with the secondaries of transformers placed in pairs upon poles, at such points along the primary line as may best serve local requirements. This plan dispenses with the necessity of maintaining any kind of a distributing station in the village. The circuits are so laid out that, with very few exceptions, every consumer is within 500 feet of one of the distributing poles with its pair of transformers, from which the secondary mains radiate as required. There are at the present time six of these distributing poles in the main village, besides one at West Peterborough, a small mill-village about midway of the line, where two or three dwellings and a few street-lamps are lighted.

One of these distributing poles is shown in the initial letter of this article and may serve as a characteristic type of them all. The transformers are mounted on vertical iron bars between two cross-arms, one transformer being on each side of the pole. Upon the upper cross-arm are fixed four lightning arresters, "T. H., Type E.," two for each transformer. Arresters are also placed at the switchboard in the power-house, and at the ends of each of the branches of the primary lines. The intermediate distributing pole at West Peterborough is likewise provided with arresters. These have thus far proved an effectual protection, no injury from lightning other than the occasional blowing of a fuse having ever occurred since the plant has been in operation.

The secondary mains are carried on glass-and-pin insulators on a second cross-arm, placed at the usual distance below the first one. The gauges of these mains of course vary according to the load intended to be accommodated. Some of the smallest are of No. 8 with a neutral wire of No. 10, and the largest are of No. 3 with a neutral wire of No. 6. The interior wiring is arranged in accordance with the usual Edison 3-wire plan of distribution. The secondary mains may be seen in the illustration radiating in various directions from the distributing pole, in some cases

running parallel to the primary wires, and in other cases diverging at various angles, as may be necessary to reach individual consumers. (See diagram on this page.)

The distributing organization may therefore be regarded in effect as a group of small local plants, each consisting of a system of triple mains in which a pair of transformers takes the place of the pair of dynamos of the original Edison system. The loss in the transformers and secondary mains together, under ordinary conditions, can scarcely exceed 5 or 6 per cent.

The maximum variation of potential throughout the entire system is said to be less than 2 per cent.

THE MUNICIPAL LIGHTING.

There are in all, at the present time, 81 street lights of 25 candle-power each, 9 of these being in the west village and the remaining 72 in the centre. These are fixed upon curved iron arms affixed to the regular line-poles, projecting about five feet towards the middle of the street so as to support the lamp, with its hood-reflector, about 15 feet from the ground. In the more thickly built-up portion of the main streets, a lamp is placed upon every pole, but in more remote parts of the village upon every alternate pole. The lights are therefore, as a general rule, either 125 or 250 feet apart. Each lamp is fed directly from the secondary mains, and consequently at a potential of 104 volts.

A critical examination satisfied the writer that the illumination in the central part of the village was admirable. The lamps appeared to be clean and fully up to their rated candle-power, and experiment showed it to be practicable to discover and pick up a pin at any point on the sidewalk on either side of a 60-foot street, on which the lamps were 125 feet apart and all on one side of the street. The height of the lamps was such that the light was thoroughly diffused and not intercepted by tree-branches, although some of the streets were heavily shaded with elms, as is usually the case in New England villages. The illumination of the 250-foot spaces in the less frequented streets appeared to be quite sufficient for all practical purposes.

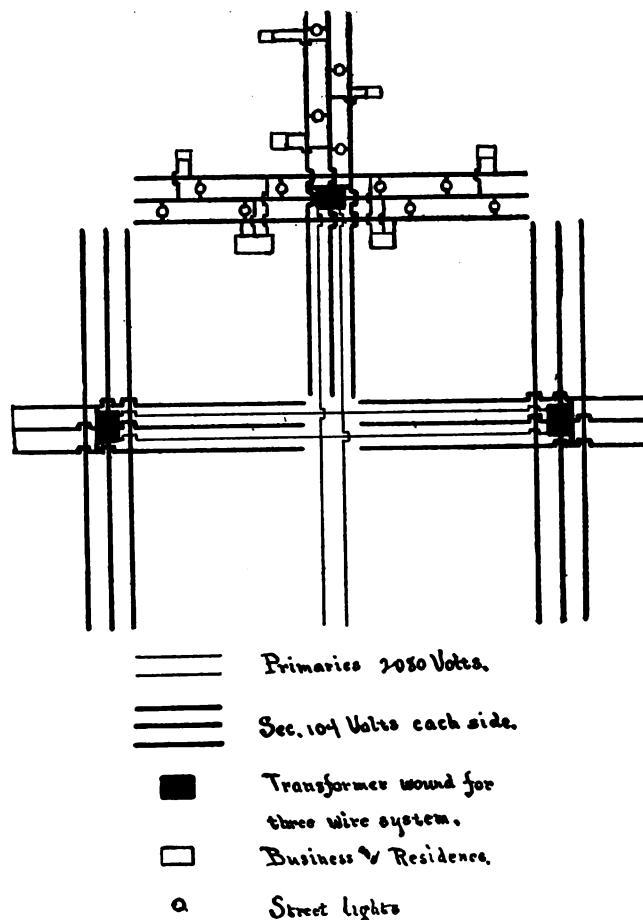
MISCELLANEOUS NOTES OF INTEREST.

The total number of lamps at present wired on the system, including street-lamps, is in the neighborhood of 1,000, thus averaging about 70 lamps to each transformer. The average current going out from the station was stated to be 13 or 14 amperes, occasionally reaching a maximum of 17. As is usual in towns of the same class, citizens of moderate means have been very slow in adopting electric lighting for their dwellings; the comparatively few private residences lighted being nearly all those of the more wealthy class of citizens. Thus far, the charges have been based entirely on the contract system; perhaps with a hope of inducing a larger number of small consumers to supply themselves than would otherwise be the case. It seems questionable whether this policy is, on the whole, a wise one, for although the enforcement of the rule requiring consumers to pay for their own renewals no doubt affords a considerable check upon excessive consumption, it is quite conceivable that at some future time the maximum load may exceed the capacity of the water-power, in which case the necessary readjustment of the rates would be likely to cause a good deal of dissatisfaction among the consumers.

One interesting feature of the Peterborough plant is an arrangement providing for the occasional lighting of a grove in the public park. This grove is composed of fine old trees, and overshadows a natural amphitheatre an acre or so in extent directly adjacent to the river. It is fitted with a dancing platform, band-stand, rustic benches and tables, etc., and is evidently a favorite place for pic-nics, open-air meetings and public entertainments. A network of overhead wires affixed to trees sustains the necessary

number of lamp-sockets and, whenever required, it is but the work of a few minutes for the electrician to insert the lamps and turn on the current. Colored lamps are sometimes very effectively used. On these festive occasions the illuminated grove forms one of the principal attractions of the village.

Perhaps the most noticeable features of the Peterborough plant are the skilful manner in which it has been laid out, and the thoroughness with which it has been constructed. Every dollar seems to have been put where it would tell, and so far as is apparent to the casual observer, not a dollar has been wasted. This excellence of design and construction makes it possible for one competent man to superintend and run the entire plant without skilled assistance, thus reducing the operating expenses to a low figure. The superintendent, Mr. S. E. Wetherill, a graduate of the Lynn factory, lives in the village. During



METHOD OF 8-WIRE ALTERNATING DISTRIBUTION,
PETERBOROUGH, N. H.

the daytime he has at his disposal several hours for inspecting the distributing system, renewing lamps, and attending to such construction and repairs as may be needed from time to time. About sunset he drives out to the power-house, gets the machinery ready and starts up, running until midnight, and then drives back to his home. It would seem to be rather close work for one man to attend to it all, but it has nevertheless been successfully done for more than a year past; the plant having been started on August 15, 1893.

Only two interruptions worthy of mention have occurred since the plant began to supply current; one of these was due to the washing out of the raceway by a sudden flood, and the other to the breakage of the main belt. The distributing system appears to operate in the most satisfactory manner, the candle-power of the lamps, according to the observations of the writer, being remarkably

uniform, irrespective of the amount of load upon the dynamo.

The writer is not in possession of any information as to the financial results of this particular enterprise, but it is possible, from the facts which have been given, to form an estimate which cannot be far out of the way for a plant of corresponding capacity, under like conditions.

At current prices, the cost of such an outfit as that at Peterborough, would be about as follows :

1 60-k. w. alternator, with station appliances.....	\$2,000
14 50-light transformers, at \$65.....	910
Freight and setting up dynamo.....	100
185 80-ft. poles, set, with arms and insulators, at \$8.75.....	694
50 85-ft. poles, set, with arms and insulators, at \$4.50.....	225
40,000 feet No. 8 (primaries).....	1,600
15,000 " averaging No. 4 (secondaries).....	495
900 incandescent lamps and sockets, at .60.....	540
Wiring for 900 lamps.....	1,800
81 street lamps, fixtures and labor, at \$6.....	486
80 lightning arresters, at \$5.....	150
Service line and telephones, say.....	125
100 10-light meters, at \$12.50.....	1,250
Miscellaneous small supplies, say.....	100
Engineering and sundries.....	525
	\$11,000

In the present instance, surplus power is leased from the sawmill ; it ought not therefore to cost over, say, \$400 per annum; probably it is actually considerably less. Twelve per cent. should cover interest and depreciation, and \$1,500

The conditions at Peterborough are, of course, exceptionally favorable, by reason of the low cost of water-power, but it is probable that equally favorable opportunities might be found in the neighborhood of many other towns of similar size and requirements. It might even be possible to reduce the price of service to consumers, so that each domestic lamp should earn but \$5 per annum instead of \$8 as estimated above, if such reduction should result in giving the dynamo a full load, and yet enable the plant to earn a very handsome return on the cost of the plant. On the other hand, if a full load for the dynamo could be obtained at standard prices for current, such a plant might obviously become a very profitable one, considering the very moderate amount of the original investment.

ELECTRICAL MACHINIST-PRACTICE.—II.

BY

James F. Hobart,

THE soldering of commutator connections is an operation which requires considerable care and patience, and the proper tools should be provided. The soldering copper should especially be particularly well adapted to the work to be done. The ordinary form of tool supplied for commutator soldering, usually looks something like that shown

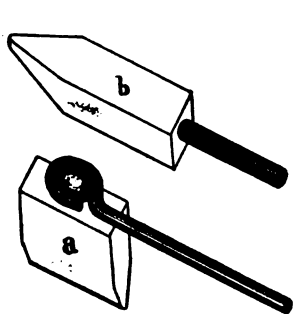


FIG. 6.

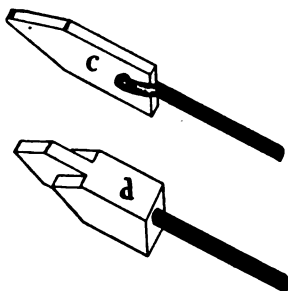


FIG. 7.

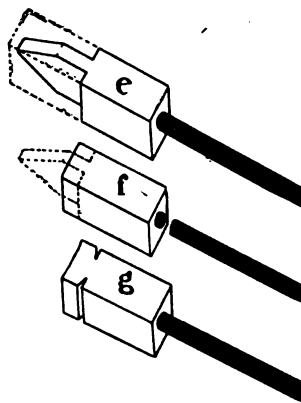


FIG. 8.

should be a sufficient allowance for the wages of a competent operator and manager. A medium and usual price for incandescent street lamps running every night until midnight, is \$.8 per year each. For current sold to consumers, we may fairly reckon 1 cent per 16 c. p. lamp per hour, although in the present case, under the contract system, it is undoubtedly sold at a figure considerably below this.

Assuming the plant working at an average output of 14 amperes,—less than half its maximum capacity,—the yearly results might figure out something like this :—

Receipts.

80 street-lamps at \$18 each (6,000 watts).....	\$1,440 00
440 consumer's lamps, average \$3 each (23,000 watts).....	3,520 00
	\$4,960 00

Expenses.

Interest and Depreciation, 12% on \$11,000.....	\$1,320 00
Rent of water-power.....	400 00
Wages of manager and operator.....	1,500 00
Contingencies, say.....	250 00
	\$3,470 00

Balance available for dividends,.... \$1,490 00

at *a*, Fig. 6. It is technically known as a "hatchet bit." Such a tool will answer very well for *unsoldering* commutator connections, but it is not desirable for making such connections.

The diagram shown at *b*, Fig. 6, is another very common form of soldering tool, and the above remarks apply equally well to this also. The end of the bit being tapering, it cannot get far into the commutator slot, and a good job of soldering, under such circumstances, is not always certain, but due a good deal to chance, and *that* is something the electrical machinist has no use for.

If a tool like *b* must be used, the point should be flattened down to a parallel thickness, so that it will go to the bottom of the slot; then a good soldering job can be done; but the tool is not as good in that shape as one shown later on.

A common form of commutator soldering bit is illustrated in Fig. 7, by diagram *c*. This tool will go to the bottom of a slot, but it cannot hold much heat, there being very little body to the tool. The instrument shown by diagram *d*, does not possess the above defect. The body of the tool keeps hot a long time, and the pointed projection on each side of the main tool helps very much to keep the point hot by conducting heat down to it. This is

why that tool is so much better than the forged form shown by Fig. 8, at *f*, the dotted line representing the tool after forging, the full lines indicating the shape of material before shaping.

In Fig. 8, diagram *g* shows the stock before forging, a couple of cuts being made with a cold chisel as shown, and the part beyond the shoulders thus formed, being drawn out under the hammer to look like the dotted shape in diagram *f*. The handle may either be cast into the blank as at *g*, or it may be threaded and screwed in, as represented by diagram *f*.

The tool shown at *d*, Fig. 7, is best formed by a shaper, or by direct casting. Diagram *e*, Fig. 8, illustrates another form of tool which has been planed out of the solid on a shaper; but this tool is not nearly as good as the one shown at *d* owing to the loss in conductivity, from absence of the corners already mentioned.

To solder a commutator to all its connections, in the best manner possible, is a job, which can only be done by first tinning the slots completely. This is best done by having the soldering bit well tinned, the slots clean, and well fluxed with rosin. This may be best applied by dissolving it in alcohol; the spirits will evaporate and leave a thin coating of gum on the surface to be tinned.

Heat the copper hot enough to melt the solder freely. The bit should not be hot enough to cause any oxide (dross) to appear on the film of solder which forms the "tinning" of the tool. By holding the copper for a second or two within three inches of the face, the degree of heat can be closely judged after a very little experience.

Keep the copper bit thoroughly tinned. If the tool is not overheated, it will not require retinning for some time after being thoroughly covered first. About the best method of tinning, is to select a soft burned (yellow) brick and melt some solder and rosin on top thereof. Rub the surface of the copper to be tinned, on the brick, taking care to have it barely hot enough to melt the solder. It is not easy to tin a very hot copper, as the surface oxidizes before it can be covered with the melted solder.

The copper will rub up brick dust which mixes with the rosin and forms an excellent grinding material to brighten the surface of the tool so that the melted solder can spread itself over the copper. By working on an edge of the brick, the tool shown in diagram *d*, Fig. 7, may be tinned clear up into the angles or corners. Tinning this part of the surface does not directly help the soldering, but it does assist in tinning the slots because when the point of the tool is down in the slot, solder may be melted on the upper part of the tool, and will flow into the slot if the tool is tinned, but not otherwise.

Tool *d*, which is shaped to nearly fill the slot, tins both sides and the bottom at the same time. Only enough solder should be fed in to cover the surfaces, for if enough is put in to form drops on the sides, it will be difficult to get the wires in place without stopping to chip out the superfluous solder.

Modern armature winding requires that the winding shall be so planned that the coils may be wound on forms, then removed and taped before being put into the slots. Also, that each slot be filled with two half coils, the half coils being separately wound and taped, and the wires leading to commutator shall be laid together and taped, and laid in the slots with insulation on, until all the commutator connections have been taped and put in place. This prevents the clean copper wires from being soiled by handling, and when the insulation is scraped off, the wire is ready to unite by soldering, without danger of a poor joint through oxidization of the wire surface, poor tinning of slots, or incomplete soldering.

MR. M. O. SLOCUM who has been connected with Western Electric Co. in New York has gone to the Chicago office of that company.

MAGNETIC LEAKAGE IN DYNAMO-ELECTRIC MACHINERY.—V.

BY

Alfred E. Whence.

(D.) Relative Permeance across Pole Pieces. (P_r).

The amount of leakage across the end and side-surfaces of the pole pieces, that is, across all their surfaces not facing the armature-core depends upon the shape of the polepieces, and upon the design of the machine with reference to an external iron surface (bedplate) near the polepieces.

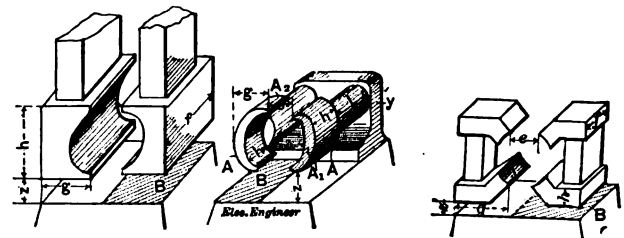
For the most usual shapes the following formulæ can be derived for the relative permeance across the polepieces:

a. Pole Pieces having an external iron Surface opposite them.

1. Upright Horseshoe Type.

In the upright horseshoe type, Fig. 22, the entire direct leakage across the polepieces can be assumed to pass through the iron bedplate, hence:

$$P_r = \frac{1}{2} \left[f \times \left(g + \frac{h}{2} \right) + B \right] \dots \dots \dots (31)$$



FIGS. 22, 23 AND 24.

$B = \frac{1}{2}$ area of iron surface facing pole-pieces (centre portion of bedplate), in sq. ins.;
 $z =$ Distance from pole piece to iron surface (height of zinc base), in inches;

f, g, h , are dimensions in inches, see Fig. 22.

2. Horizontal Horseshoe Type.

In this type, Fig. 23, the lines from the lower halves of the pole-pieces leak to the bedplate, while from the upper halves, and from the end surfaces they pass across the pole-gaps:

$$P_r = \frac{1}{2} \frac{(A + B)}{z} + \frac{A + A_1}{e + g \times \frac{\pi}{4}} \dots \dots \dots (32)$$

$A =$ Surface of Polepiece opposite bedplate ($= \frac{1}{2}$ of external surface);
 $A_1 =$ End Surface of Polepiece;
 $B =$ Half area of iron surface facing polepieces (or area of portion opposite one pole piece).

3. Fourpolar Double Magnet Type.

In machines of this type, Fig. 24, there are two leakage paths across the polepieces, the lines from the lower pair of polepieces passing across the bedplate; those from the upper pair across the pole-gap:

$$P_r = \frac{1}{2} \frac{[f \times (g + 2h) + B]}{z} + \frac{g \times (f + 2h)}{e_1 + g \times \frac{\pi}{4}} \dots \dots (33)$$

Since there are no further essential leakages in this type, formula (33) gives the entire relative permeance of the waste paths for the fourpolar double magnet type.

β. Pole Pieces having no external iron surface opposite them.

1. *Inverted Horseshoe Type with rectangular Pole-Pieces.*

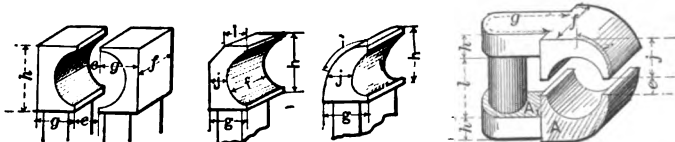
For rectangular polepieces, Fig. 25, the mean length of all leakage paths are equal, and the relative permeance between the polepieces may consequently be expressed by:

$$P_s = \frac{g \times (f + 2h)}{e + g \times \frac{\pi}{2}} \dots\dots\dots (34)$$

2. *Inverted Horseshoe Type with bevelled or rounded Pole Pieces.*

In beveled and rounded polepieces, Figs. 26 and 27, respectively, the length of the path across the upper surfaces is somewhat smaller than that of the side surfaces, and the permeance formula consists of two terms:

$$P_s = \frac{i \times f}{e + i \times \frac{\pi}{2}} + \frac{2h \times j}{e + g \times \frac{\pi}{2}} \dots\dots\dots (35)$$



FIGS. 25, 26, 27 AND 28.

3. *Single Magnet Type.*

Here there are four distinct paths for the leakage lines from polepiece to polepiece, viz., across the end surfaces of the yoke-ports, end surfaces of the pole-ports, across the facing surfaces of the pole-ports, and the inside projections of the pole portions; hence we obtain, with reference to Fig. 28:

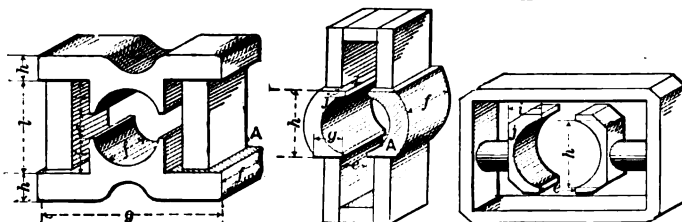
$$P_s = \frac{g \times h}{l + h \times \frac{\pi}{2}} + \frac{2A + f \times i}{e + j} + \frac{A_1}{l} + \frac{f \times (j - h)}{e + (j - h)} \dots\dots\dots (36)$$

All leakage paths of the single magnet type being considered in this formula (36) gives the total relative permeance of the waste field of that type.

4. *Double Magnet Type.*

There is no leakage between the magnet-cores nor between polepieces and yoke in this type, the total stray permeance of the double magnet type, Fig. 29, therefore, is given by the formula:

$$P_s = 2 \left[\frac{(g + f) \times h + A}{l} + \frac{f \times i}{e + i} \right] \dots\dots\dots (37)$$



FIGS. 29, 30 AND 31.

5. *Double Horseshoe Type.*

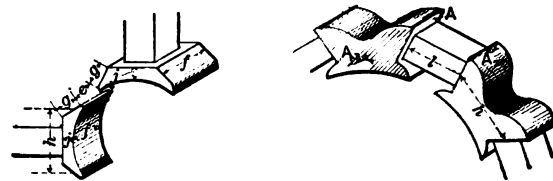
In the double horseshoe type, Fig. 30, the only leakage across the pole pieces takes place at the end surfaces and at the pole corners, hence we have for this, and for similar symmetrical bipolar types:

$$P_s = 2 \times \left[\frac{A}{e + g \times \frac{\pi}{2}} + \frac{j \times f}{e} + \frac{i \times f}{e + i \times \frac{\pi}{2}} \right] \dots\dots\dots (38)$$

6. *Iron Clad Type.*

In iron clad types, Fig. 31, the leakage from the end surfaces and the back surface of the pole pieces take place to the yoke, see formula (47); for the permeance across the polepieces, only the side surfaces are to be considered, and we obtain:

$$P_s = \frac{h \times (i + j)}{e + i \times \frac{\pi}{2}} \dots\dots\dots (39)$$



FIGS. 32 AND 33.

7. *Radial Multipolar Type.*

In radial multipolar dynamos, Fig. 32, lines pass from the end surfaces of the pole-pieces across the pole-gaps:

$$P_s = 2p \left[\frac{g \times f}{e + g \times \frac{\pi}{2}} + \frac{h \times j}{e + \frac{h}{2} \times \frac{\pi}{2}} \right] \dots\dots\dots (40)$$

p = number of pairs of magnet poles.

8. *Tangential Multipolar Type.*

The leakage between adjacent polepieces in tangential multipolar machines, Fig. 33, takes place across the length of the magnet-cores:

$$P_s = 2p \times \left(\frac{A}{l} + \frac{A_1 + A_2}{l + h \times \frac{\pi}{4}} \right) \dots\dots\dots (41)$$

A = Area of projecting portion of end surface, = end-surface — area of magnet core;

A_1 = Area of side surface of polepiece;

A_2 = Half area of external surface of polepiece.

ELECTRICITY IN THE SOUTH.

Mr. I. Ullman, of Birmingham, Ala., writes us with regard to the development of electrical industries in the South, and the necessity that has not yet been fully realized there for careful construction and economical operation. As he points out, it is not enough to buy a plant of some standard system, and then to sit down, expecting it to earn dividends. He adds:—"The South Eastern Tariff Association has formulated a code of fire insurance regulations, covering most points deserving attention; and although we may take issue with them on some of their specifications yet as a whole they are admirably adapted to the practice and advancement of the profession. Still it is an undeniable fact that a large majority of Southern towns and villages in which are located electrical plants, pay not the least regard to the S. E. T. A. rules on installation. The question then is proper:—To what is this attributable? Inspection has grown to be a hollow term. Few superintendents are familiar with methods for making required tests, and decay is a natural resultant. A system suffering for want of repair, consequent upon grounds, faults, and other sources of trouble, must surely prove a money sinker. What we most need are fewer superintendents and managers and more electricians. The South offers excellent opportunities to the electrician if we can but place the subject before the people in the proper light and importance. Perhaps our insurance companies will find it to their interest in the near future to adopt a policy requiring an inspector at every point in the person of the electrician in the employ of the company with city franchisees, and the electrician to be required to pass an examination outlined by the Association. Certainly some such step would hasten a much needed reform, besides advancing the general interest of the trade.

LITTLE ROCK'S REIGN OF DARKNESS.

THE streets of Little Rock were in darkness recently. Some malicious person entered the power house of the city electric light plant and poured a quart of sulphuric acid on the four dynamos, which destroyed the insulation in all of them. The dynamos were new, and cost \$60,000.

ELECTRIC TRANSPORTATION DEPARTMENT.

THE ELECTRIC BRAKE IN PRACTICE.¹—I.

BY ELMER A. SPERRY.

Examination of accounts of the electric street railway companies of our large cities reveals the fact that the item of damage, already very great, is one of growing importance. Investigation of the circumstances and detailed statements of numerous items taken at random from the damage account, point at once and in no uncertain way to the inefficiency of the present hand brake. In many instances, could the car or train have been stopped within a comparatively short distance, the accident and resultant damages would have been entirely averted. The first investigation led to others with the same result, and in consequence the writer is prepared to show that nearly 85 per cent. of the accidents directly occurring, are due to the inefficient operation of brakes.

The question naturally arises, will any system of braking worked upon or in connection with the ordinary wheel of a vehicle be sufficient for the stop required? What is the maximum efficiency obtainable by the brake working through the wheels? Is it sufficient to arrest the car before accident in case of emergency? Can it be made in any event a sufficient accident preventer? The popular notion that most accidents are due to brake failure is true, but in a way that is little understood, the failure being one of degree. It may not be known that under proper and standard conditions any car or train may be brought from a speed of 10 miles an hour to absolute rest inside of 10 feet. It is not generally appreciated that the wheel brake has ample capacity to accomplish this. The former investigations of the writer with reference to adhesion under conditions of acceleration and retardation, climbing and descending hills, afford ample proof that the rail adhesion through the wheels gives the wheel brake more than capacity sufficient to accomplish this result.

The author then gives the results of experiments embodied in a table, showing that the power applied by the steady pull of the average motorman is about 181 7 lbs., and can be made to run up in case both hands and the weight of the body are used, to about 224 lbs., average, but this value cannot be maintained. The tests show that the full power that can be maintained upon the brake lever for a sufficient length of time for the purposes in hand, does not exceed an average of 180 lbs. Another table gives the results of experiments with a brake shoe that had been run in service about three or four days; this was taken with the axle carrying its co-operating wheel, lifted out of the truck and placed between the centres of a lathe, the load upon the brake shoe accurately measured, and the shoe held from movement around the wheel by a dynamometer.

Tracing the 180 lbs. application to the brake beam with allowance for loss by friction, gave 8,840 lbs. applied to each of the two shoes which upon the chilled surfaces are found under ordinary circumstances, to give a coefficient of about 12 per cent. This would give a retarding effect of 460 lbs. which is less than one-third that easily obtainable were the power needful for its application at hand. The coefficient under these conditions would have been about 37 per cent. to realize anything like the total value of the retarding effect of the wheel. This under condition of chilled and glazed surface is entirely out of the question, showing at once the necessity of power in the application of brakes, if anything like their full value and use is to be obtained. This is also amply borne out in practice, as those who have tested this point well know that under ordinary conditions it is next to impossible to slip the wheels of a motor car by the hand brake.

In practice the greatest necessity for maximum brake application exists at the higher speeds. The results of experiments show that at just this point the failure is greatest, the coefficients being least; increasing as the speeds decrease. This has always constituted the one grave fault of the air brake in railway service. The intensity of its application should be greatest when the speed is greatest, and decrease as the speed drops off. As will be shown farther on, this point has been fully covered in the electric brake, which is the first time that the varying application has ever been embodied in practice, and especially in such a manner as to perform its important function automatically.

The electric brake under discussion has been operated over a year on equipment upon different roads, from electricity generated

independently of the trolley connection, the braking current not being derived from the central station but produced by the power of the moving car, which power it is desired to get rid of, or destroy. The brake thus operates equally well with the trolley off, and, as will be understood from the following description, the trolley current has nothing at all to do with the car while the brake is being operated, except possibly to maintain the light circuit. The current employed by the writer for operating the brakes is developed by automatically turning the motor or motors into generators. As these are driven forward by the moving car they develop current which is controlled as to intensity by the starting rheostat of the car. The braking current is thus produced at the expense of the mechanical energy stored up in the moving car, which, being consumed causes a retardation and final stopping of the mass as a whole. The current so generated may be furthermore led through a brake magnet as above seen, to apply the brake shoes; it may arrest the motion of the car direct by magnetic adhesion, or develop heavy retarding currents in the moving metallic mass by magneto-induction. When an active local circuit is used, the latter method is usually employed for reasons which will be made more apparent.

In developing this system, the point which seemed fraught with the most difficulty, and which has finally received the simplest solution of any in connection with the problem, was that of obtaining always and with absolute certainty, sufficient current at the lowest speeds without the aid of the trolley current. Teaser coils were at intervals resorted to, maintaining connection with the trolley circuit. "Artificial teasers" were also used, being a device by means of which the trolley circuit was entirely done away with, and which worked well. Observations made from time to time in connection with these experiments led to an exhaustive investigation of residual magnetism, in consequence of which, structural means were adopted to utilize to the full, the residual magnetism of the motor. This supply is constantly being renewed with every energizing of the car. This method was found to be the simplest as well as the most effective. The connections, and in fact the whole arrangement of the electric brake upon the car, is extremely simple. This is shown by the fact that only one small extra wire needs to be run to the controller in addition to the ordinary wiring of the standard equipment without the electric brake. The certainty of operation is evinced by the fact that at present writing over 150 of the equipments have been placed, which are making upwards of 10,000 miles daily in regular service. Early in the experimentation a phenomenon was observed in reference to the persistence of the current even after the motor had stopped. This is due to the slow action of the decreasing magnetization, taken together with the reaction or self-induction effect of the fields and any brake coil or coils that may be in the circuit. The movement of the magnetic lines, which persist after, and in fact long after, the motion of the motor has ceased, generates potential. In many instances it is possible to draw an arc from the rupture of the brake circuit one second after the motion has ceased, showing the presence of current in the local circuit. The current flowing after motion ceases, though small, is found exceedingly useful in holding the car from starting itself, even on quite a heavy grade, as only a small quantity of energy added to the already great friction of quiescence will prevent the car from starting. This persistency of current is also found useful to kill or destroy the magnetism of the brake magnet, in case it is desired to suddenly move the car forward again. The tendency on the part of the windings at the moment of rupture to generate an opposing E. M. F., tends to suddenly free the magnet from its face, a purely accidental feature, which is of great value and utility in this connection. The wonderful energy of the withdrawal of the lines of force, being in its manifestations a phenomenon of magnetic viscosity, is illustrated by the following fact: With a perfectly dry track, a great force is required to shear the adhesion and start the wheels slipping. A car going down a grade under these conditions where no brake magnets are present, will, with a sudden application of the electric brake, generate sufficient current to not only arrest the motion of the wheels, but start them going in the opposite direction, the reverse motion being maintained through an interval truly remarkable, in some instances running as high as one and one-half seconds. It will be borne in mind that all the above phenomena are entirely independent of the central station current, the trolley connection having been severed before the brake is applied.

The current required to be developed to stop a car when no other braking apparatus is used, is found to be only a fraction of that required to accelerate the car in the same interval.

1. Abstract of a paper to be presented at the Meeting of the American Institute of Electrical Engineers, New York and Chicago, September 19, 1894. An illustrated description of the Sperry brake was published in the *ENGINEER* of September 12th.

TWELFTH ANNUAL MEETING N. Y. STATE STREET RAILWAY ASSOCIATION.

The twelfth annual meeting of the Association was held at the Yates House, Syracuse, N. Y., on September 16. There was an attendance of about fifty members and trade representatives. President D. B. Hasbrouck presided and made a neat speech. The first item of importance was the reading of a report on "Economy in Electric Power Stations" by Mr. J. B. Craven, the electrician of the Buffalo Street Railway. This paper touched briefly on a number of points. Mr. Craven recommended refined plain coal oil for the prevention of boiler scale. He had used it for two years putting a pint per day in each boiler, letting it enter with the feed-water by means of a sight feed lubricator. As to direct connection, he said: "In my mind there is no doubt of the efficiency of the direct connected unit over the belted one. It is evident to all that where space is valuable it has the advantage of taking up less room. They can be thrown in and out of service with as much rapidity as the belt driven machine; there is a saving of from 1½ to 3 per cent. due to the slipping of belts, very little in itself, but when figured up at the end of a year in a plant of any size will amount to considerable. Added to this there is the saving in labor and the decreased expense due to wear and tear, as this item is less in slow speed than high speed machinery." With regard to engine care, Mr. Craven mentioned the fact that he had had one engineer use \$640 worth more of oil in six months than another who got a greater capacity out of the engines. The paper was briefly discussed by Messrs. Cole, Seely and Isertel.

A paper was then read on "Recent Improvements in Cable Traction," by Mr. George W. McNulty, of New York City.

A paper was also read by Mr. A. R. Foote, expounding his well-known views on corporate taxation.

The following officers were then elected: President G. Tracy Rogers, Binghamton; first vice-president, John H. Moffitt, Syracuse; second vice-president, W. W. Cole, Elmira; secretary and treasurer, W. J. Richardson, Brooklyn. Executive Committee: D. B. Hasbrouck, John N. Beckley and D. F. Lewis. The next place of meeting will be Albany, N. Y. The report of the executive committee showed 80 companies in membership, the largest number yet reached.

Apparatus and supplies were shown by H. W. Johns Co.; Consolidated Car Heating Co.; Taylor Electric Truck Co.; Cutter Electrical Mfg. Co.; Davis Automatic Car Shade Co.; and Peckham Motor Truck and Wheel Co.

During the afternoon the visitors drove around the city to various points of interest and inspected the new track of the Syracuse Street Railway Co. In the evening they attended a very pleasant complimentary banquet.

THE TROLLEY MANIA IN PHILADELPHIA.

Now that the electric railway has firmly established itself in Philadelphia notwithstanding the bitter opposition of so many citizens of that conservative town, it has become a source of merriment and gaiety to the town. On every clear night, says the *Philadelphia Bulletin*, there are scores of "excursion" cars, filled with men, women and children in an extraordinary state of effervescence and delight. Such joyous animation has not been seen on our streets after nightfall for many a day, and despite the tribute of dead cats and watermelon rinds which greet these nocturnal invasions in downtown streets, the railway companies which have gone into this "excursion" business cannot supply the demand for the open cars. What with hurdy-gurdys, fife, drums, fish-horns, tom-toms, whistles, fire crackers and all the other devices for setting up a "racket," in addition to the lusty yells of the participants, any one within ear shot of the cars who tries to woo sleep these August nights, or who is stretched on a bed of sickness, has abundant reason for asking the companies to regulate their excursions in a less boisterous fashion. If they do not, the police should, because there is no doubt that a good thing has been overdone and has nearly reached the stage of a nuisance. It is almost as much of a terror on some streets as would be a New Year eve celebration night after night.

MOVING HOUSES BY TROLLEY.

A NOVEL and successful application of the trolley was recently seen in Hoboken, N. J. A good-sized frame house was being moved and en route to its final destination had to cross the electric railway tracks. As the wires, of course, had to be cut and traffic suspended during the passage of the building it was desirable that this should occupy as little time as possible. A car was therefore put at the disposal of the movers, and when the house had been brought as near the track as possible tackle was rigged about blocks across the street and attached to the rear coupling. The wires were then cut and cleared away and the car moved off, drawing the house quickly across the tracks and out of the way. The wires were reconnected and traffic was resumed, the whole operation occupying but a few minutes.

ELECTRIC FREIGHT LINE IN ALBANY.

It is expected that the new electric freight cars to run between Albany and Troy will be in service by October. The cars are smaller than the passenger cars and are built to carry about ten tons. They are painted brown with light colored trimmings. The interior is finished in light wood which is polished, and is lighted by four incandescent lamps.

THE ST. LOUIS ELECTRIC AMBULANCE.

The City of St. Louis has adopted a plan of conveying patients from the Dispensary to the City Hospital by means of an electric car fitted up as an ambulance. It is intended to run the car to all parts of the city in response to ambulance calls, and an average speed of twelve miles an hour will be permitted.

THE TROLLEY AND THE INTERSTATE COMMERCE LAW.

The Rock Creek Electric Street Railway, running from Washington into Maryland, where an inn is located, is charged with giving a special rate of fare to guests of the inn, and will, it is said, be prosecuted under the Interstate Commerce Law.

COLLEGE NOTES.

ARMOUR INSTITUTE.

The Armour Institute, Chicago, has published a prospectus of its course in the "Department of Electricity and Electrical Engineering," of which Prof. Wilber M. Stine, Ph. D., is Director. The course extends over a period of four years and is perhaps more distinctively electrical than is common with electrical schools. To this end both lectures and laboratory work on electrical subjects, extend throughout the four years. This marked emphasis has been placed on the electrical portion of this course to accomplish the most thorough training both in theory and practice, in the hope that students may upon its completion be immediately available for commercial work, and that it may by careful and conscientious conduct in a great measure bridge over the hiatus between the school on the one hand and the electrical factory, central station, or usual engineering practice on the other. Due prominence is given to the idea that a thoroughly trained electrical engineer must be equally well grounded in mechanical and steam engineering and machine-shop practice. The degree conferred upon the completion of the full course in electricity is Bachelor of Science in Electrical Engineering. Upon the completion of an additional year of resident postgraduate electrical and mechanical study and testing, or after two years of actual engineering work, the degree of Electrical Engineer is conferred.

ELECTRICAL ENGINEERING LECTURES.

A COURSE of twenty-five lectures on Electrical Engineering, by Mr. Max Osterberg, E. E., graduate of Columbia College, is to be given on Saturday evenings, beginning October 6th, 1894, in the Young Men's Christian Association Building, corner Twenty-third street and Fourth avenue, New York. Tickets, \$6. For further information apply to Educational Secretary, Waldo H. Sherman, 52 East Twenty-third street, or to Mr. Osterberg, 282 East Sixty-second street, on or before October 1, 1894.

UNIVERSITY OF ILLINOIS.

THE new Engineering Hall of the University of Illinois at Champaign is rapidly nearing completion and is the handsomest and best equipped building in the University group, and one of the largest and finest buildings devoted wholly to engineering education in the country. The various laboratories are well equipped for practical instruction in Applied Mechanics, Mechanical Engineering, Electrical Engineering, Civil Engineering and Architecture.

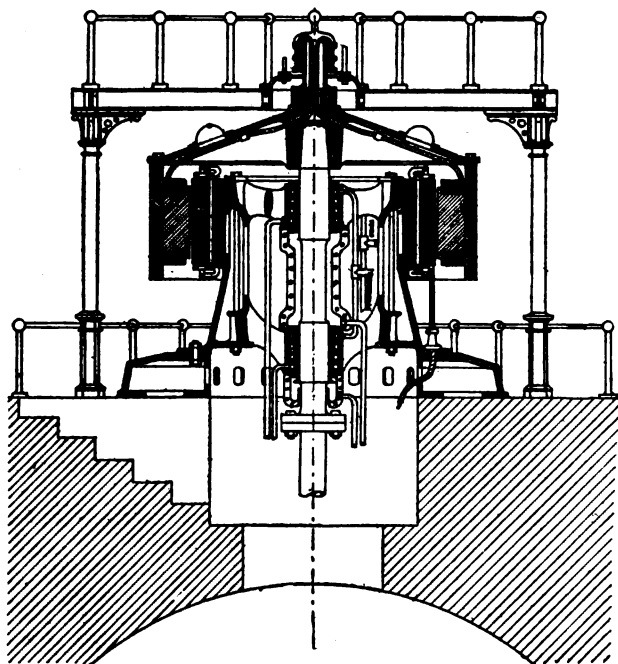
TWO TARIFFS.—The *Canadian Manufacturer*, of Toronto, has made a hit by bringing out in its issue of Sept. 7, in addition to its other regular matter, the two new tariffs, that of the United States which has just gone into force and that of Canada, which was ratified July 23, this year. Not only is the comparison thus afforded very useful, but the issue has a permanent value for all doing trade with these countries or between them. It is noteworthy that our new tariff is generally higher than the Canadian, but one would hardly have supposed that our manufacturers needed more encouragement than those of Canada. The *Manufacturer*, which is most ably and intelligently conducted and is very well informed, expects good results from both tariffs.

THE 5,000 H.P. DYNAMOS FOR NIAGARA.

THOUGH nearly all the details of the methods of operation and the construction of the turbines to be employed at Niagara Falls have been published, nothing had thus far been vouchsafed on the actual construction of the three 5,000 H.P. alternators now rapidly nearing completion at the works of the Westinghouse Company at Pittsburgh. Our readers will therefore be interested in the description of the actual machines to be installed, one of which is illustrated in the accompanying engraving, showing the general arrangement in elevation and the dynamo itself in section.

To a circular foundation is bolted a vertical cast iron cylinder, provided with a flange on which the stationary armature rests. The inner part of the cylinder is bored to the shape of an inverted cone and serves as a bearing for another conical piece of cast iron, supporting the shaft-bearings. The armature core is made of thin, oxidized iron plates, held together by 8 nickel-steel bolts. In the outer edge of the plates are 187 rectangular holes to receive the armature winding.

The outer rotating field magnet consists of a wrought steel ring to which are bolted the 12, inwardly projecting, massive cast iron polepieces. The ring constituting the field magnet is supported by a six-armed cast-steel spider keyed to a vertical axis. The field-magnets act also as a flywheel. The shaft rests on two bearings supported by four arms projecting from the inner adjust-



5,000 H. P. WESTINGHOUSE ALTERNATOR FOR NIAGARA AND THE PROPOSED FORBES ALTERNATOR.

able cast-iron cylinder. The bushings of the bearings are made of bronze provided with zig-zag grooves in which oil constantly circulates. On the outer side of the bushing there are also grooves into which cold water may be pumped, if required.

The armature-conductors are rectangular copper bars, 32 x 8 millimetres. Each of the 187 holes of the armature contains two of these bars, surrounded with mica. The upper and under sides of the armature are connected by means of V-shaped copper bars, riveted to the ends of the bars which project out behind the ends of the armature. The connections are made so as to give two independent circuits. A pair of cables connects each circuit with the switchboard.

The magnet-winding also is composed of bent copper bars, air-insulated, inclosed in brass boxes, two of which are fastened to each pole-piece. Continuous current for exciting the field magnets is obtained from a rotary transformer.

The current is conducted to the field coils by means of a pair of brushes and two copper rings fixed to the top of the shaft of the generator. At a speed of 250 revolutions per minute the machine produces two alternating currents, differing in phase of 90 degs. from each other, each of 775 amperes and 2,250 volts pressure. The alternations are 50 per second. The height from base of bed plate to top of machine is nearly 18½ feet.

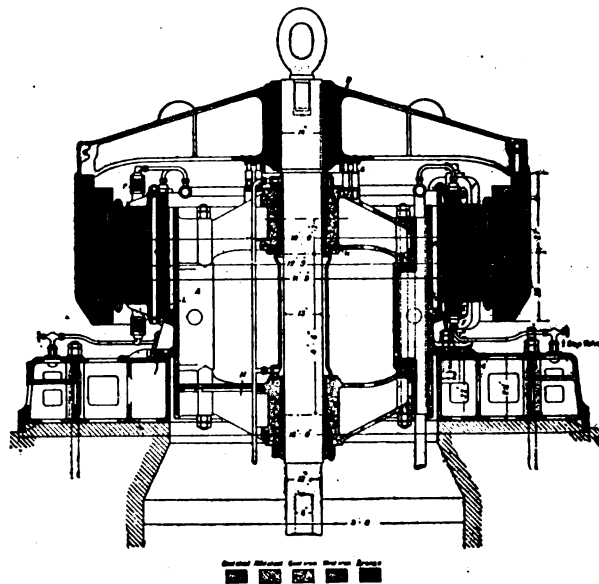
As a matter of interest we add the illustration of the machine as originally specified by Prof. Forbes for this work and described in his paper before the London Institution of Electrical Engineers. See THE ELECTRICAL ENGINEER, March 14, 1894. We understand that the bed plate of the first of the three machines has lately been delivered at Niagara.

ELECTRICAL SUBWAYS FOR BALTIMORE.

The White-Crosby Co. has been awarded the contract for building the new Baltimore electrical subways, by the Electrical Subway Commission of that city. The bids submitted were as follows;—that of the White-Crosby Company being specially approved by Engineer Nicholas S. Hill, Jr. :—

White Crosby Company, Baltimore—Creosoted wood pump log, in brick, 8-inch duct, 2-inch subsidiary, \$64,712.48; 2½-inch duct, 2-inch subsidiary, \$59,980.89; creosoted wood, sectional class, in brick, 8-inch duct, 2-inch subsidiary, \$65,180.88; 2½-inch duct, 2-inch subsidiary, \$61,765.04; wrought iron pipe, in cast iron, 8-inch duct, 2-inch subsidiary, \$92,510.88; 2½-inch duct, 2-inch subsidiary, \$81,822.64; cement-lined tube, in brick, 8-inch duct, 2-inch subsidiary, \$88,187.26; 2½-inch duct, 2-inch subsidiary, \$81,414.66; terra cotta, Camp class, in brick, 8-inch duct, 2-inch subsidiary, \$68,487.84; 2½-inch duct, 2-inch subsidiary, \$60,828.18; 8-inch duct, 8-inch subsidiary, \$64,629.97; terra cotta, Lynch class, in brick, 8-inch duct, 2-inch subsidiary, \$59,792.61.

The Complete Electric Construction Company of New York—Treated wrought-iron pipe in brick, 8-inch duct, 2-inch subsidiary, \$100,240.88; 2½-inch duct, 2-inch subsidiary, \$86,265.80; creosoted wood pump log or McDonald, in brick, 8-inch duct, 2-inch subsidiary, \$77,797.77; 2½-inch duct, 2-inch subsidiary, \$77,526.76; cement-lined tube in brick, 8-inch duct, 2-inch subsidiary, \$88,890.82; 2½-inch duct, 2-inch subsidiary, \$81,970.04; terra cotta, Camp class in brick, 8-inch duct, 2-inch subsidiary, \$81,154.28; 2½-inch duct, 2-inch subsidiary, \$80,674.11.



David E. Evans & Co., Baltimore—Terra cotta, Lynch class, in brick, types A and B, 2-inch subsidiary, \$54,718.07; treated wrought iron pipe in brick, types A and D, 8-inch duct, 2-inch subsidiary, \$91,190.84; 2½-inch duct, 2-inch subsidiary, \$79,615.14;

The Connecticut Pipe Manufacturing Company, New Haven, Conn.—Cement-lined pipe, in brick, 8-inch duct, 2-inch subsidiary; \$107,908.42; 2½-inch duct, 2-inch subsidiary, \$100,835.99.

The McCay-Howard Engineering Company, Baltimore—Terra cotta, Lynch class, in brick, 8-inch duct, 2-inch subsidiary, \$56,678.23; 2½-inch duct, 2-inch subsidiary, \$57,044.81; cement-lined pipe, in brick, 8-inch duct, 2-inch subsidiary, \$68,800.04; 2½-inch duct, 2-inch subsidiary, \$66,999.39; treated wrought-iron pipe, in brick, 8-inch duct, 2-inch subsidiary, \$78,502.62; creosoted duct, 2-inch subsidiary, \$78,502.62; creosoted wood, in brick, 8-inch duct, 2-inch subsidiary, \$57,357.14; 2½-inch duct, 2-inch subsidiary, \$52,494.40.

These subways are intended for fire alarm, police, and patrol wires, and the system will also connect with that of the Chesapeake & Potomac Telephone Co., in Baltimore.

MR. ALBERT E. WIENER was married on September 20 to Miss Lilia D. Benedict, of Schenectady.

PROF. BARRETT's book on Electricity at the World's Fair has now appeared. It is handsomely bound in stamped gilt cloth, and its 500 pages of interesting text are most profusely illustrated. We can supply copies at \$2.50, postage free.

THE ELECTRICAL ENGINEER.

(INCORPORATED)

PUBLISHED EVERY WEDNESDAY AT

303 Broadway, New York.

Telephone: 3360 Cortlandt.

Cable Address: LENGINEER.

Geo. M. Phelps, President.

F. R. COLVIN, Treas. and Business Manager.

Edited by

T. COMMERFORD MARTIN AND JOSEPH WITELER.

Associate Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—630 Atlantic Avenue, Boston, Mass.

Western Editor and Manager O. KAMMEYER, 1439 Monadnock Building, Chicago, Ill.

New York Representative, 303 Broadway, } W. F. HANKE.
Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada	- - - - -	per annum, \$3.00
Four or more Copies, in Clubs (each)	- - - - -	2.50
Great Britain and other Foreign Countries within the Postal Union	- - - - -	5.00
Single Copies,	- - - - -	.10

[Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1893.]

EDITORIAL ANNOUNCEMENTS.

Addresses.—Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of THE ELECTRICAL ENGINEER. Communications for the attention of the editors should be addressed, EDITOR OF THE ELECTRICAL ENGINEER, 303 Broadway, New York City.

VOL. XVIII. NEW YORK, SEPTEMBER 26, 1894. No. 334.

CONTENTS.

EDITORIAL :—	PAGE.
Iron Interior Conduits.....	364
Making Small Plants Pay.....	365
Sour Grapes.....	365
The Monocyclic System.....	365
ARTICLES :—	
Electric Lighting by Water Power at Peterborough, N. H. (Illustr.).....	245
Electrical Machinist Practice.—II. (Illustr.).....	248
Magnetic Leakage in Dynamo-Electric Machinery.—V. (Illustr.).....	249
The 5,000 H. P. Dynamo for Niagara (Illustr.).....	253
Operation of Induction Motors on the General Electric Company's Monocyclic System (Illustr.).....	256
Fourth Annual Convention of the Canadian Electrical Association at Montreal.....	257
ELECTRIC TRANSPORTATION DEPARTMENT :—	
The Electric Brake in Practice.—I.....	251
Twelfth Annual Meeting of the N. Y. State Street Railway Association.—The Trolley Mania in Philadelphia.—Moving Houses by Trolley.—Electric Freight Line in Albany.—The St. Louis Electric Ambulance.—The Trolley and the Interstate Commerce Law.....	253
NEWS AND NOTES :—	
Electricity in the South.....	250
Little Book's Reign of Darkness.....	250
Two Tariffs.....	252
Electrical Subways for Baltimore.....	255
Mr. A. E. Wiener.....	255
"Electricity at the World's Fair".....	256
Production of Electricity by the Evaporation of Liquid Carbon Dioxide.....	258
COLLEGE NOTES :—	
Armour Institute.....	253
Electrical Engineering Lectures.....	253
University of Illinois.....	253
SOCIETY AND CLUB NOTES :—	
The Old Time Telegraphers' Association and the Society of the U. S. Military Telegraph Corps.....	258
American Institute of Electrical Engineers.....	258
National Society of Electro-Therapists.....	258
American Electro-Therapeutic Association.....	258
LEGAL NOTES :—	
Field Patent Defeated.....	259
Adams Patent Invalid.....	259
Converter Litigation.....	259
LETTERS TO EDITOR :—	
Morse Apparatus on Telephone Lines.....	259
INVENTORS' RECORD :—	
Classified Digest of U. S. Electrical Patents Issued September 11 and 18, 1894.....	260
TRADE NOTES AND NOVELTIES AND MECHANICAL DEPARTMENT :—	
Gas Engines for Electric Lighting (Illustr.)—The Falk Trolley Wheel (Illustr.)—Warren & Lozier.....	261
Woonsocket Electric Co.'s New Water Power Plant (Illustr.)—Exhaust Steam Heating.—Revival of Trade.....	262
Webster Feed Water Heater and Purifier (Illustr.)—Standard Electric Co., of Philadelphia, Receivership.—Block Lighting in New York.—The Turnbull Incandescent Lamp (Illustr.)—A Neat Battery Resistance Switch.....	263
An "Ajax" 7,000 Ampere Switch (Illustr.)—Phoenix Carbon Mfg. Co.—New Siemens & Halske Catalogues.—New England Notes.....	264

IRON INTERIOR CONDUITS.

THE art of interior electric wiring has passed through probably as many changes and modifications as that of any one department into which the generation and distribution of electricity may be divided. Beginning with the underwriter's wire fastened to the wall by braces, it has undergone numerous stages until, as a result of stern experience, it was found that an electrical conductor ought to be as thoroughly well housed and accessible as a conductor of gas or water. This gave rise to the now well-known interior conduits, which may be truthfully said to have created a new era in interior wiring. But excellent as this system is in principle it would be too much to claim that it had reached finality and that improvement was not to be hoped for; indeed, even the original promoters of the system are far, we believe, from insisting on this point. Beginning with the paper tube impregnated with a bitumen compound, experience soon showed the desirability of an armor, which was provided in the shape of a brass covering, and as a more recent development we note the employment of iron pipe.

The application and advantages of conduits have also been well recognized by the various Boards of Fire Underwriters but the application of iron tubing for this purpose is so new that as yet we have noticed only one fire underwriter's association that has taken up the question, and has formulated rules relating to it. Supplement No. 2 to the "Electric Light and Power Rules and Requirements of the New England Insurance Exchange," recently issued, reads as follows :—

RULE 22. INTERIOR CONDUITS.—Amend Section (e) to read as follows :—

e. Must not be supplied with a twin conductor, or two separate conductors, in a single tube.

NOTE.—The use of two *Standard* wires, either separate or twin conductor, in a straight conduit installation is approved in the *iron armored* conduit of the Interior Conduit and Insulation Co., but not in any of the other approved conduits.

Notice of the approval of certain wires and materials, and the interpretation of certain rules.

RULE 23. INTERIOR CONDUITS :—

The American Circular Loom Co. Tube, the *brass sheathed* and the *iron armored* tubes made by the Interior Conduit and Insulation Company, and the Vulca Tube are approved for the class of work called for in this rule.

It will be noticed that this rule is a radical departure from the practice which has heretofore obtained, requiring a separate tube for each conductor. At first sight, and in view particularly of the character of the iron tube, such a ruling would appear anomalous, but a little consideration will show that the rule is a salutary one, considering especially the phenomena accompanying the alternating current. With a single conductor carrying alternating current in an iron tube, currents are induced in the pipe itself, which not only cause loss of pressure in circuits but generate currents in the body of the tube which may become dangerous. With the two conductors in the tube constituting lead and return this action is, of course, avoided. Moreover economy of space and material is effected without loss of safety.

While the use of iron armored conduits has thus been officially sanctioned, it would seem that there are some who hold to the idea that the plain, bare iron pipe, without any insulation material on the interior walls is all-sufficient to the protection of an otherwise well insulated wire, such as the rules call for. The advocates of this method, can, we think, hardly have fully considered the results which must follow such a method. Besides the undoubtedly higher insulation resistance which an iron conduit lined with insulating material, such as prepared paper, com-

pound or enamel, would lend to the system, the application of such a lining must give the tube a smoothness, which would avoid any injury to the wire while drawing in,—a guarantee which could certainly not be afforded by the bare iron pipe.

But in addition to guarding the conductor during its introduction into the tube the insulated interior also acts as a protector essential to the very life of the insulator immediately surrounding the conductor. Experience, in fact, has shown that it is practically impossible to prevent moisture from entering these tubes and rusting them; and the effect of iron rust in prolonged contact with insulating material is too well known to require pointing out at this late day.

For those who argue that, other things being equal, a conduit composed of iron pipe with *insulating joints* would be as effective as one insulated throughout on the interior, we need only point out that for safeguard against abnormal currents the outer metallic conduit should be well grounded so as to cause an immediate low resistance and blowing of the fuse in case of the grounding of the circuit on the metal of the pipe. For reasons of personal safety, especially in connection with the alternating system, a good grounding of the iron pipe is of paramount importance,—as much so, as the grounding of converter cases, now universally practiced. The results already obtained with insulated iron conduits leaves little room for doubt that they will in time become the standard for interior work, just as they have been found to be among the best adapted for underground distribution. As between the insulated and uninsulated iron conduit there can be but one conclusion and one choice.

MAKING SMALL PLANTS PAY.

WE published recently, as our readers will remember, a report on municipal electric light plants in this country, admirably analyzed and discussed by Mr. Horatio A. Foster, who took occasion to point out that many or most of the plants are very small and that their expenses were therefore likely to be unduly high. He did not urge this as an excuse for their absence of economy, but emphasized it as one of the conditions that prevents them for obtaining a favorable relation between income and expenditure. The same remark stands true, of course, with regard to small private stations, and it has long been held that one of the most difficult things in the range of practical electrical application is to get good dividends out of small stations. The returns from small electric roads are believed to average higher on the investment for the reason that the plant instead of earning only for five or six hours daily is in operation at least sixteen or seventeen hours; so that the same margin of profit per kilowatt of output for a small road will enable it to pay dividends where an electric lighting plant cannot possibly do it. According to the statement of Mr. W. J. Buckley in his useful manual on "Electric Lighting Plants" just issued, 12.6 per cent. of operating stations are losing money; 10.8 per cent. barely earn their running expenses, and 76.6 per cent. are making from 2 to 51 per cent. yearly on the investment. It is a pity Mr. Buckley could not have split up the largest group into smaller ones, so that we might know how many stations pay 2 per cent. and how many 50. It is pretty safe to assume that the 50 class is rather select.

Admitting the difficulties in the way of the smaller stations that supply light only, it has seemed to us that they should earn more than they do; and as a step towards getting more data on a very vital and interesting point we have printed in this issue a careful report on a small plant at Peterborough, N. H., by Mr. Franklin L. Pope,

who has gone into a careful description of all the conditions pertaining to the operation of the station, and who shows that it is in fair shape to earn, net, about \$1,500 on an investment of \$11,000. This is roundly 14 per cent., and if the station is, from some unsuspected or special reason earning in reality but half that, it still remains a lesson of hope and encouragement. The general subject is so important and interesting, we shall be glad to receive contributions from any quarter, to the discussion.

SOUR GRAPES.

THE "feeder and main" patent, being found invalid by the Appellate Court, is really "of no consequence" say the General Electric Company. "The effect of the decision upon that company will be next to nothing, as it will not decrease its business one iota," says one of its leading counsel, Mr. F. P. Fish, in an interview printed in the *Evening Post*, the day after the decision. It is interesting to turn to the last annual report of the General Electric Company and to find that Mr. Coffin therein said the "feeder and main" patent—which had been held good by the lower court—was of "fundamental importance." Mr. Fish further said, in the interview quoted above; "All along the operators of the high-tension system have used the 'feeder and main' apparatus where they found it to be desirable. Its chief utility is on low-tension apparatus, which is controlled by the General Electric Company," which seems to mean that the owners of the patent attached no importance to the use of feeders and mains on high tension plants. But they brought suit against the Torrington Electric Light Co.—operating an alternating current system—and, since Judge Green's decision of March 1893, sued the New York Insulated Wire Co. for installing feeders and mains on the World's Fair lighting plant of the Westinghouse company; both of which suits of course fall to the ground now. It seems hardly worth while for the distinguished counsel quoted to seek to minimize the significance of the adverse judgment in this case. Perhaps it will be in order to write off some portion of the \$8,000,000 carried for Patents and Franchises when preparing the next annual report of the General Electric Company.

THE MONOCYCLIC SYSTEM.

THE introduction of the polyphase system has done much to bring the alternating current into prominence as a medium for power transmission, but it would be too much to maintain that it had fully met the conditions of a general method of alternating *distribution* adapted for both lighting and power, in the sense that this term is applied to the continuous current. It cannot be denied that the majority of alternating current central station managers look askance at a system which, besides requiring three or more wires, introduces difficulties in the way of balancing of circuits which the average station staff is hardly qualified to maintain. What has been wanted is a system which would leave the lighting independent of the power consumption and this without the introduction of auxiliary devices requiring attention and involving additional expense. The solution offered in the "monocyclic" system of the General Electric Co., described on another page, is another laudable attempt to meet the requirements in a satisfactory manner. The introduction of a third wire of small section for the operation of the motors alone will not be considered as a barrier to a system possessing undoubted merits in other respects and it is to be hoped that the results of more extended application of the system will soon be available for purposes of comparison.

OPERATION OF INDUCTION MOTORS ON THE GENERAL ELECTRIC CO.'S MONOCYCLIC SYSTEM.

THE introduction of the alternating system of distribution created a new era in the history of the industry and to it is due largely the present extent of electric lighting in the United States.

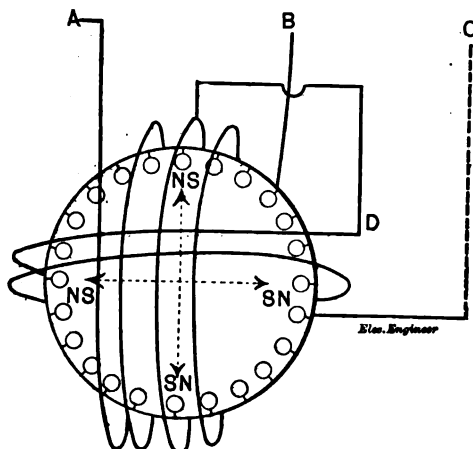


FIG. 1.

But while fulfilling eminently the demands of the hour so far as electric lighting was concerned the system had until quite recently labored under the great disadvantage that it afforded no means for the application of power, as no alternating motor suitable for such circuits was available. The bringing out of the two-phase and

The general assumption that for the efficient working, and especially the starting of induction motors, polyphase currents are necessary has, it is asserted, been found by careful investigation, to be based upon the erroneous interpretation of experiments. If in the induction motor, Fig. 1, one coil AB is excited by a single phase alternating current, in the short circuited armature coils beneath field coil AB, a secondary current is induced, which lags 90 degs. behind the magnetism produced by coil AB. This secondary coil polarizes in the same direction as AB, and thus does not give a rotating torque. If, however, by some external means a magnetic pole is produced at right angles with the polarization of coil AB, and displaced in phase, this pole is just in the position to give the maximum torque with the induced current in the armature, and thereby starts the motor at full torque.

As will be seen, no polyphase currents are needed for such self-starting induction motors, but merely a supplementary field coil, which requires only the expenditure of sufficient magnetizing, i. e., practically wattless, current (except a small $C^2 R$ loss) in the supplementary coil DC.

While such a motor is running, the induced current in the armature, carried along by the rotation of the armature, and unable to die out quickly, due to the short circuited conductors surrounding the armature, produces this displaced pole, and even induces an E. M. F. in the coil DC sufficient to give a magnetizing current for the supplementary coil of any other motor running from the same mains AB by connecting them with the corresponding terminal of the other motor.

Thus, by connecting all the single phase motors with supplementary coils DC with each other by an equalizing wire C, as long as one motor is running, any other motor is able to start at full torque. This equalizing wire C conveys no energy current, but merely the small amount of magnetizing current required in starting, and thus needs to have a small cross section only. Carrying, however, wire C back to the generator and connecting it there with a small supplementary coil wound on the generator armature the magnetizing current required for starting the motor by means of coil DC can be supplied by the generator also, and thus the first motor starting on the system

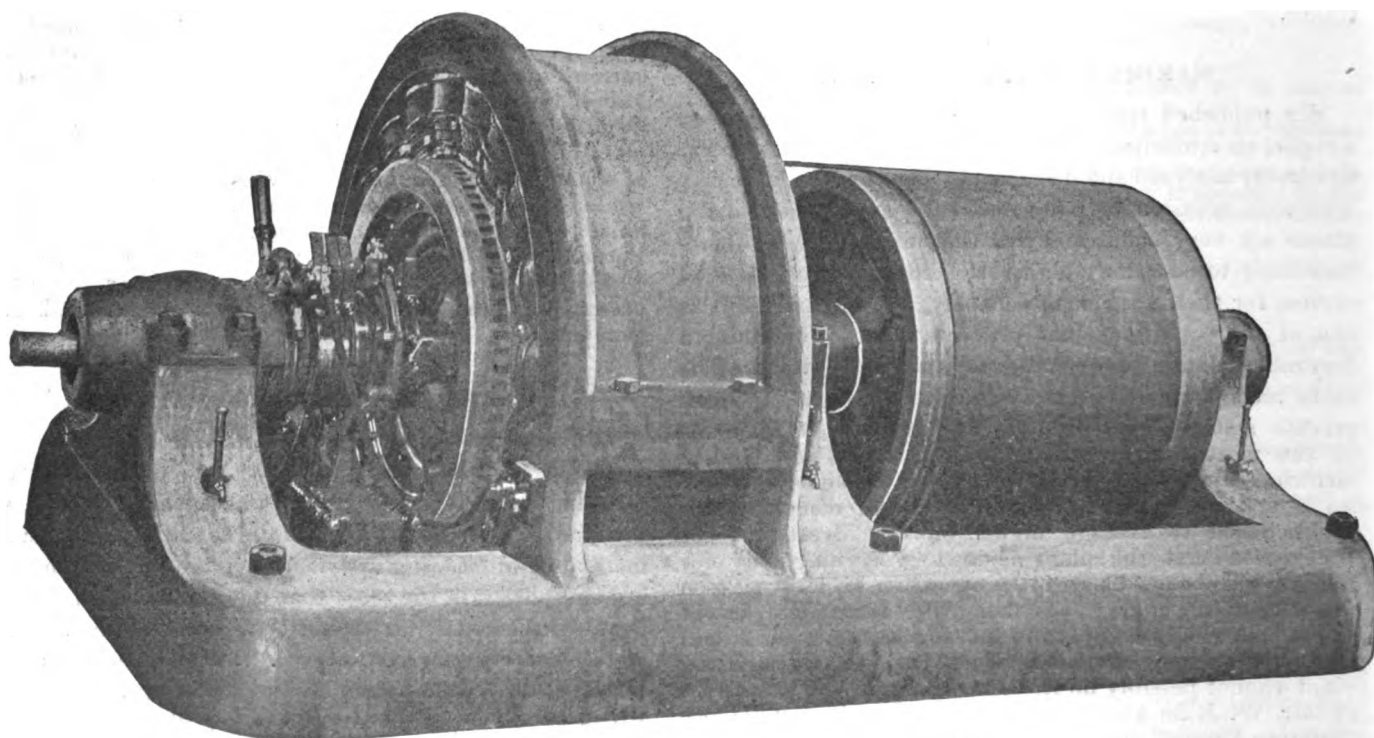


FIG. 2.—GENERAL ELECTRIC CO.'S 300 KILOWATT MONOCYCLIC ALTERNATING GENERATOR.

three-phase systems permitted the use of the alternating current, it is true, but these motors are not adapted for use on single-phase circuits, at present in universal use. It is true also that single-phase synchronous motors have, in a few instances, been employed and are successfully at work at the present time, but their nature precludes them from use as machines for general power distribution, in the manner in which continuous current motors are applied at the present day for all purposes and ranges of power.

It was with the object of supplying a system which would admit of furnishing alternating current for lighting and power purposes from the same generator that the General Electric Co. has just perfected its "monocyclic" system of distribution.

will receive the magnetizing current from the generator, and all the other motors indiscriminately from the generator or parallel running motors, thereby making these single phase motors self-starting under full load and over load. It will thus be seen that where light only is required the ordinary two supply wires are alone necessary; but where motors are to be operated, only then is the third or power wire called into requisition.

The standard periodicity employed is 60 cycles per second—7,200 alternations per minute. This frequency was selected because, all in all, it seemed best suited to the requirements of power transmission under the conditions usually found. It is sufficiently high to permit the ready use of incandescent and arc lamps, and the employment of standard transformers. On the

other hand, it is low enough to permit the use of induction motors under the most advantageous conditions, and to avoid all serious trouble from self-inductive and static effects on the line, except at very great distances. For very long distance work, 83 periods has been adopted.

The line current is led into the exterior field of the motor, which is constructed of thoroughly annealed laminated iron, while the armature, of similar material, is wound with a comparatively small number of heavy copper bars, united at the ends by substantial connectors. The armature is furnished with a starting resistance of very simple and solid construction, which is placed within the armature spider.

At starting, a collar sliding along the shaft is kept out of contact with the three-part switch blade, whose office is to short circuit the resistance in question. When the motor is nearly, or quite, at speed the contact ring is slid along the shaft until it engages the switch points, thus short circuiting the armature on itself. The result of this arrangement is that it becomes possible to obtain a large starting effort with a current limited to a reasonable amount by the resistance, and in all the General Electric Company's induction motors this resistance is so adjusted as to give a starting torque 50 per cent. larger than the running torque at full load. If a greater starting effort is desired it can be obtained by the use of a special resistance adapted to the case, so that three or four times the normal running torque can be obtained at starting, as sometimes becomes necessary in hoisting and other severe service, at the expense of a larger starting current.

Owing to the simplicity of the construction of these motors and the massive character of the armature winding, in which the voltage is very small, burnouts are almost impossible, and the absence of commutator and collecting rings obviates the danger of sparking.

Our illustration Fig. 2 shows the 300 K. W. monocyclic alternating generator, running at 850 revolutions and over compounded 15%.

FOURTH ANNUAL CONVENTION OF THE CANADIAN ELECTRICAL ASSOCIATION AT MONTREAL, SEPTEMBER 19, 20 AND 21.

The fourth annual convention was opened at 11 A. M. September 19, in the Board Trade Building, by the President, MR. J. J. WRIGHT, who, in delivering his address, congratulated the members upon the flourishing condition of the association and the character of the papers to be read. He expressed pleasure at the large attendance and was glad to see several American Electricians present, whom he invited to take part in the proceedings.

MR. C. H. MORTIMER, the secretary-treasurer, then read his report which briefly reviewed the business of the past year, and showed that the affairs of the association were in a very satisfactory condition. The membership included 99 active and 88 associate members, which number would be increased by the admission of new members whose applications had been received since the last executive meeting.

The financial condition was also good, as there was a balance of over \$300 on hand at the end of the year. The present balance is about \$350.

After the adoption of the report, an address of welcome was presented by MR. J. J. YORK on behalf of the Montreal members of the Canadian Association of Stationary Engineers, which was replied to by President Wright.

MR. THOS. D. LOCKWOOD, of Boston, who was present, was unanimously elected an honorary member of the association and then made a few remarks expressing his thanks for the honor and congratulating the Association upon its eclecticism, as shown by the wide range of subjects covered by the papers to be read.

It was then proposed by MR. K. J. DUNSTAN and seconded by MR. A. B. SMITH that the annual membership fee for active members be reduced from \$5.00 to \$3.00 to take effect from June 1st, 1894. This proposition was referred to a committee, who, after consideration reported favorably upon it in the afternoon. The report was adopted. A letter was then read from MR. GRANVILLE C. CUNNINGHAM, Managing Director of the Montreal Street Railway Co., inviting the members to visit the power station of the Company. A letter was also read from MR. A. J. CORRIEVEAU, Manager of the Montreal Park and Island Railway Co., extending an invitation to a trip over that road.

At the opening of the afternoon session, the President made the following appointments as authorized by a resolution passed in the morning.

Committee on Statistics: E. C. Breithaupt, John Langton and John Galt.

Committee on Constitution and By-Laws: J. A. Kammerer, A. M. Wickens, A. B. Smith and K. J. Dunstan.

Committee on Legislation: J. B. Powell, L. B. MacFarlane and John Yule.

At the afternoon session the first paper read was that by MR. W. B. SHAW, of Montreal, on "The Application of Electricity for Medical and Kindred Purposes, from Light and Power Circuits."

The author described the devices by means of which dentists, oculists and other specialists apply the electric current to their patients, and then took up the electrical work of the general practitioner and showed how readily it may all be accomplished with a straight current of 110 volts from the street mains, a proper rheostat and one or two cells of accumulator, dispensing with the cumbersome cabinet and apparatus generally used. In closing he described a complete outfit as adapted to the conditions obtaining in Montreal, i. e., from a 52 volt alternating and a 250 volt direct circuit.

In the discussion which followed, reference was made to the fact brought out by the paper that catering to the electrical wants of medical men and dentists was well worth the consideration of the electrical fraternity. Reference was also made to the increasing use of electricity by physicians and specialists.

MR. J. A. BAYLIS, of the Bell Telephone Company, Toronto, then read his paper on "Electrolysis," confining his remarks to the electrolytic corrosion of underground pipes and conductors by stray earth currents. He quoted some of the remedies that have been suggested and tried for the elimination of the nuisance, such as grounding the positive pole of the dynamo and putting the negative to line, breaking the metallic continuity of the pipes and cables, and frequently reversing the polarity of the railway currents, and stated that the only sure cure for this trouble, as far as we know at present, is in the adoption of some other street railway system than that of the single trolley with track return; such as a double trolley system, storage batteries, or alternating currents, if a practical motor can be constructed.

The ensuing discussion was participated in by both telephone and street railway men and the consensus of opinion was that in small cities but little damage was done by electrolysis and that in large cities it could be minimized by proper precautions.

A paper followed by MR. L. M. PINOLET, of Montreal, on "Alternating Current Motors" which led to a lively discussion, after which the meeting adjourned.

In the evening, the members attended a theatre party by invitation of the Packard Lamp Co., of Montreal, which company also presented each member at the convention with a handsome silver scarf pin representing a miniature incandescent lamp.

On Thursday morning the members visited the Engineering Building at McGill University and inspected its fine electrical and other laboratories by invitation of the Faculty of Applied Science. PROF. CARUS-WILSON acted as guide and also gave a brief and instructive address outlining the methods of testing transformers and giving a practical illustration by means of a Siemens dynamometer and a Kelvin balance with a special device of his own for increasing its range. The commercial method was illustrated by a Weston dynamometer.

At the morning session, which opened at 11 A. M., a paper was read by MR. E. CARL BREITHAUPT, of Berlin, Ont., on "Municipal Electric Lighting."

The paper was followed by considerable discussion, the general opinion being that municipal plants were more expensive to operate than those of private companies and that, as shown recently by THE ELECTRICAL ENGINEER, the reports as to the wonderful cheapness of their operation were disproved by careful investigation.

At the afternoon session, the first paper was read by MR. D. H. KEELY, of Ottawa, on "A Method of Distribution with Equalization of Potential Difference" which was listened to with much interest and led to an animated discussion.

MR. O. HIGMAN, Government Electrician of the Department of Inland Revenue, Ottawa, then made a few remarks outlining the provisions of the new Electric Light Inspection Act. According to the Act, the variation in pressure of the current supplied to the terminals of a consumer's wires must not exceed 3% from the normal pressure, but Mr. Higman thought this requirement might prove somewhat cramping. If companies contract to supply lights of a specified candle power, then the testing of the lamps would probably come under the Act. In reply to a question as to the possibility of the elimination of the word "nominal" in arc lighting contracts, he replied that he did not think it desirable. Also, if the companies were required to furnish a particular specified number of watts to each arc lamp, it might give them the opportunity of using poor lamps and poor carbons. It was the intention at present to confine the operation of the Act to the large cities.

With regard to the appointment of inspectors, Mr. Higman said the present gas inspectors were very intelligent men and with a little instruction would make competent electrical meter inspectors.

The general opinion of the members of the Association seemed to be that the requirement that the variation of potential at a consumer's terminals must not exceed 3% from a stated pressure, was too severe. Several thought at least 8% should have been allowed. Mr. Higman then stated that it was not the intention of the Government to interpret this provision too severely.

MR. JOHN LANGTON, of Toronto, then read a paper entitled "Note on Possible Reduction of Station Plant on Small Electric Railways by Multiple Series Control of Motors."

His paper was short and concise, stating that for large roads

the principal value of multiple series control is the ability to run slowly with good efficiency in crowded streets, and the saving of wear and tear on switch and rheostat at such times and at starting. On small roads with a few cars running on fifteen to twenty minutes headway it is more a question of communication than of continuously rapid transit; and, as has been shown, by sacrificing speed up hill a substantial reduction in the first cost of power plant may be achieved, without any sacrifice of ability to run at high speed on the level and low grades. The horse power hours drawn from the station would be the same per car trip in either case, but by easing off the starting current and slowing up on grades, the power would be drawn more uniformly, with the tendency to reduce the variations of load on the steam engines. This should give better economy in steam consumption, but it is not at all probable that there would be any noticeable effect on the coal bill.

The President then presented the paper of MR. JOHN GALT, of Toronto, who was unavoidably absent, on "The Possibility of Securing Better Regulation at Central Light and Power Stations by means of Fly Wheel Accumulators of Improved Construction."

The meeting then adjourned and the members proceeded in two special cars provided by the Montreal Park and Island Railway across the Island of Montreal to Sault aux Recollets where the annual dinner of the association was held and was a great success, being thoroughly enjoyed by all.

At Friday morning's session, the first paper was read by MR. F. J. SCHWARTZ, of the Bell Telephone Co., Montreal, on "Cable Construction and Cable Faults."

Mr. Schwartz reviewed the history of cable construction as applied to telephone work and spoke of the rapid increase in the number of cables and their consequent interference with one another. He then described the principal styles of cable now in use, spoke of the faults likely to develop in them and made suggestions for their elimination. He also spoke of the care and repair of cables and illustrated his paper with views of splicing, and also a number of examples of poor construction and noteworthy faults.

PROF. T. R. ROSEBRUGH, of the School of Practical Science, Toronto, then read a paper on "Duplex Telephony." During the discussion, the fact was brought out that the first place in the world where a telephone line was duplexed was in Canada in 1878.

The author stated that there is little in common between the known methods of duplexing telegraphic transmission and those available for the telephone, and mentioned the most marked differences in detail. It is necessary, he said, in the latter case, that two points be obtained on a two-wire metallic circuit satisfying the condition that no difference of potential be produced between them by the action of the transmitter already in that circuit, and that no effect be produced in the receivers of the circuit by the entrance and exit of current at these two points. Means for satisfying these conditions by the aid of derived circuits were then described. The author thought it quite probable that on very long lines the decreased conductor resistance and self induction of the derived circuit as compared with the originals would fully counterbalance the increased electrostatic capacity, and give, for example, between New York and Chicago, three speaking circuits for every four conductors, instead of two, the transmission being unimpaired in any of the circuits.

The last paper read was that of MR. ELMER A. SPERRY, of Cleveland, Ohio, on "The Electric Brake in Practice" which was practically illustrated by one of the author's controllers and was listened to with much interest.

It was decided to hold the next convention at Ottawa. The voting for officers resulted as follows: President, K. J. Dunstan, Bell Telephone Co., Toronto; first vice-president, A. B. Smith, Great North-Western Telegraph Co., Toronto; second vice-president, C. B. Powell, Ottawa; secretary-treasurer, C. H. Mortimer, publisher *Canadian Electrical News*, Toronto. Executive Committee (old members), Geo. Black, L. B. MacFarlane, T. R. Rosebrugh, E. C. Breithaupt, John Yule; (new members): O. Higman, J. W. Taylor, D. A. Starr, J. J. Wright and J. A. Kammerer.

Votes of thanks for courtesies extended were passed to the Faculty of Applied Science of McGill University, the Montreal Park and Island Railway Co., the Bell Telephone Co., the Eugene Phillips Electrical Works, the Packard Lamp Co., all of Montreal and to Ahearn & Soper, for an invitation to visit Ottawa. The press were also thanked for their reports of the proceedings.

The convention then adjourned. In the afternoon the members were treated to a drive to Mount Royal Park, including a visit to the Montreal Street Railway Power House, by the Eugene Phillips Electrical Works.

Among those at the convention were the following: Geo. Black, Robert Dickenson, W. F. McLaren, Hamilton; J. W. Taylor, J. V. Hedenberg, W. P. Roper, H. T. Hartman, Peterborough; J. M. Campbell, Kingston; R. G. Moles, Arnprior; John Yule, Guelph; W. A. McKay, A. A. Wright, C. H. Wright, Renfrew; Andrew Sangster, Jr., Sherbrooke, Que.; C. A. Bissett, St. Johns, Que.; O. Higman, C. F. Medbury, J. E. Brown, D. H. Keeley, Ottawa; E. C. Breithaupt, Berlin, Ont.; A. B. Smith, K. J. Dunstan, J. J. Wright, Jas. A. Baylis, J. C. Gardner, T. R. Rosebrugh, A. M. Wickens, G. White-Fraser, W. Bourne, C. H.

Mortimer, Toronto; John Carroll, L. B. MacFarlane, W. B. Shaw, D. A. Starr, C. G. Paige, Fred. Thomson, F. J. F. Schwartz, J. A. Kammerer, J. Kent, W. J. Camp, W. B. Powell, J. Geen, H. Brown, Jas. Burnett, C. W. Henderson, Geo. H. Hill, A. J. Corriveau, G. W. Sadler, L. M. Piolet, Montreal; Thos. D. Lockwood, Boston, Mass; M. J. Francisco, Rutland, Vt.; Elmer A. Sperry, Cleveland, O.; W. R. McLaughlin, New York; Chas. F. Ernest, Cleveland, O.

SOCIETY AND CLUB NOTES.

THE OLD-TIME TELEGRAPHERS ASSOCIATION AND THE SOCIETY OF THE UNITED STATES MILITARY TELEGRAPH CORPS.

THE fourteenth annual meeting and reunion of these two organizations was held in Baltimore on September 12 and 13th, under the direction of Mr. Charles Seldon, general superintendent of telegraphs of the Baltimore & Ohio Railroad and president of the Old-Timers' Association. The attendance of members of this society was unusually large and much important business was transacted. The constitution was amended by changing the name to "The Old-Time Telegraphers' and Historical Association," making two years' continuous telegraphic service 20 years before the date of application necessary for eligibility to membership and making the annual dues one dollar. The officers elected were as follows: president, E. C. Cockey, New York; vice-president, R. J. Hutchinson, New York, and secretary and historian, G. C. Maynard, Washington. The next meeting will be held in New York on the second Wednesday in September, 1895.

The Military Telegraphers elected as officers for the ensuing year: President, W. R. Plum, Chicago; vice-president, W. B. Wilson, Philadelphia, and secretary and treasurer, J. E. Pettit, Chicago. The Committee on Congressional Action reported favorable progress on the bill now before Congress to establish the Corps as a recognized branch of the Army and the committee was continued with Mr. Wilson, chairman.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The September meeting of the Institute was held at headquarters on Wednesday last. At the meeting of Council, no fewer than 44 candidates were elected to associate membership. In the evening, Mr. Elmer A. Sperry read an interesting paper on "The Electric Brake in Practice." It was illustrated by experiments. The paper was also read and discussed at the same time in Chicago. A paper on "Condenser Residual Charges and Their Dependence on Temperature" by Messrs. Bedell and Kinsley, was read by title. The Council has appointed Mr. Bion J. Arnold, Honorary Local Secretary for Chicago, vice Mr. E. Caldwell, who has removed to New York.

THE NATIONAL SOCIETY OF ELECTRO-THERAPEUTISTS (homoeopaths) held their annual meeting in this city last week, when a number of papers of interest to the medical profession were read. The next meeting will be held in Boston. The following officers were elected: President, Dr. Wm. L. Jackson, Boston; first vice-president, Dr. A. S. Bailey, Atlantic City, N. J.; second vice-president, Dr. F. A. Gardner, Washington, D. C.; secretary, Dr. Clara Gary, Boston; treasurer, Dr. J. B. Garrison, New York. Dr. W. H. King and Dr. M. D. Youngman were elected to act with the officers as an executive committee.

THE AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION holds its annual meeting this week at the New York Academy of Medicine, beginning September 25. Secretary Cleaves has provided an excellent programme.

PRODUCTION OF ELECTRICITY BY THE EVAPORATION OF LIQUID CARBON-DIOXIDE.

It has been remarked by more than one observer that a strong jet of carbon dioxide obtained from its liquid may, on expanding into the atmosphere, produce an electric charge of marked intensity. Riess, Joly, Ducretet, and more recently Hausknecht, have published observations on this curious phenomenon, which are described anew by Dr. L. Bleekrode, in the July number of the *Philosophical Magazine*. Dr. Bleekrode attaches great importance to the minute particles of solid carbon dioxide, which he asserts to be present in the escaping gas, these particles, he says, having a great propensity to become electric. Under certain circumstances, the charge of electricity produced is of a negative character, under others it is positive, and the author devotes some space to an inquiry into the causes of these opposite states of electrification, and formulates a very plausible theory.

LEGAL NOTES.

ELECTRIC RAILWAY LITIGATION—THE FIELD PATENT DEFEATED.

ELECTRIC RAILWAY COMPANY OF THE UNITED STATES vs. THE JAMAICA AND BROOKLYN RAILROAD COMPANY.

After a final hearing in the interesting case above entitled, Judge Townsend, in the United States Circuit, Eastern District of New York, has handed down a decision, dismissing the bill. The suit was for infringement of the Field patent of July 16, 1889, No. 407,163.

The evidence of infringement applied to the first claim only of the patent, which is as follows:

"The combination, substantially as hereinbefore set forth, of a stationary dynamo electric generator, driven by a suitable motor, a circuit of conductors composed in part of an insulated or detached section of the line of rails of a railroad track, a wheeled vehicle movable upon or along said insulated section of track, an electro-magnetic motor mounted upon said vehicle for propelling the same and included in said circuit of conductors and a circuit-controlling device placed upon said vehicle."

The Court found infringement proved except as to one of the details of construction, but held the claim invalid. The complainant had admitted that every element of the combination existed in the art at the date of the alleged invention (Field's caveat was filed in May, 1879). After an elaborate and exhaustive examination of the case in its various aspects Judge Townsend says:

"The patentee demands the enforcement of the contract for the statutory monopoly of seventeen years, implied by his patent. The public denies the validity of the contract, on the ground of the lack of the alleged consideration.

"In such a case the court may put itself as nearly as possible in the situation of the parties, for the purpose of determining the object the respective parties had in view, and their respective rights and obligations thereunder. In this situation, the court, by a review of the state of the art, may ascertain what the public already had, what it still required, what the patentee sought to accomplish, what was the measure of his success, and what was the character of the means by which it was achieved.

"If it appears on the part of the public, that it has only received from the patentee such improvement in means or result, as the public might have procured by presenting its wants to a skillful mechanic, provided with the appliances, and knowledge, and skill, connected with the exercise of the art, then there is no reason why the patentee should be permitted to demand a monopoly as the price of a combination which would naturally have been disclosed in the ordinary development of the art.

"But if the results of the skill of the artisan still show the barrier of impracticability between the end sought and the result attained, an interval between theory and practice, a limitation upon further development, while the alleged inventor, by the exercise of a discriminating faculty, distinguishes difficulties, and estimates their proportions, and breaks down the barrier, or bridges the interval, or stretches beyond the limitation, by an instrumentality which, in the very facts of its construction and operation, by the adaptation of its mechanism to the end sought, suggests design, then he has contributed something of creative thought, he has invented this new instrumentality his contract is valid, and his monopoly should be sustained.

"Applying these tests to this case, where do we find the flash of creative thought; where the conceptions; where the contribution of an invention to the public? Not in the elements of arrangement of the combination, for they were furnished by the prior art; nor in the details of construction, or distinguishing characteristics of the combination, for they were not disclosed in the caveat, and everything which distinguishes this patent from the prior art was described by Siemens before the application was filed; not in the first practical operation, for, as to that, Edison and Siemens were first."

ADAMS ELEC. CO. vs. LINDELL ST. RY. CO.—ADAMS PATENTS INVALID.

At St. Louis, Mo., on Sept. 17, in the United States Circuit Court, Judge Priest read a decision against the Adams Electric Company in its suit for alleged infringement of a railway motor patent by the Lindell Street Railway, the decision being by United States Circuit Judge Moses Hallett, of Denver, Col., who heard the case in St. Louis last May. The case was dismissed. The suit was brought against the Lindell Railway Company as a test case, that company being the first in St. Louis to use the electric motor. Dr. Adams had claimed broadly the application of the motor to the car axle. His claims and patent have been noted several times in the ENGINEER. The Court says:—

None of the elements of the combination described in the claims was new at the date of the application; the motor and its several parts, the car-axle, the axle-boxes, the field-supporting frame and all other things mentioned in the claims were in use before that time. The form of some of the elements was changed

in the Adams combination, but it is clear that none of them were new at that time. Upon full examination of the record and the very able arguments of counsel I am not convinced of the merits of the patent.

The Adams company will appeal the case. Dr. Adams is quoted in an interview as follows:—"This decision is a great surprise to us. Judge Hallett has adopted the defendant's line of argument all through, and does not decide upon a single point at issue. We shall carry the case to the United States Court of Appeals. The decision of Judge Hallett will not affect the St. Louis and Chicago Electric Road, except that it will not be able to keep out competition as it otherwise would."

CONVERTER LITIGATION.

The Westinghouse Electric and Manufacturing Company, through its attorneys, Kerr & Curtis, has instituted a suit in the United States Circuit Court, at New York, against the General Electric Company for an injunction and damages on account of an alleged violation by the defendant company of a patent used in electrical converters, granted in 1887 to Oliver B. Shallenberger, and subsequently purchased by the Westinghouse Electric Company. The complaint charges that the Westinghouse Company is sustaining heavy losses by the unlicensed use of the converters by the General Electric Company.

LETTERS TO THE EDITOR.

MORSE APPARATUS ON TELEPHONE LINES.

It is well known that for accuracy in figures, names and many common words the Morse system is much more reliable than the telephone. It is not improbable that with the freedom of the telephone from patent restrictions, its use in combination with Morse will become very general among business subscribers at least.

There are doubtless now many exchanges having numerous subscribers, who, if they could do so, would prefer to transmit many of their messages, their orders, quotations, inquiries and answers to and from certain other subscribers, by Morse, on account of its accuracy and the advantage of having a record. Any telegraph operator will prefer handling important messages by Morse rather than by telephone as Morse is much the faster way, when accuracy is required.

In the daily conduct of business by those who are in charge, it is much more satisfactory to write (and have record of) a brief and clear despatch for transmission by the operator than to engage in a long talk by telephone with a risk of mistake at last and no record to which to refer. Many business houses already have competent operators among their employees or managers. Where this is not the case, the establishment having use for a telegraph operator has no need to employ one especially for that purpose, inasmuch, as the art is so easily and quickly acquired, and is, in fact, well known by so many young people of both sexes that the operators' duties may be readily added to those of typewriters, clerks or sales people, without additional cost.

For the delivery to and from over telephone wires, of messages between outlying points and nearest telegraph offices, the added use of the Morse system would be of great importance, inasmuch as every telephone station would be for all practical purposes a general telegraph office, and the service of the telephone system as a feeder to the telegraph would be very greatly improved by the accurate transmission of messages in Morse throughout their entire route, thus avoiding the uncertainty experienced when messages for the telegraph are transmitted a part of the way by telephone. Where there are in an exchange system a number of subscribers, who each have operators and Morse sets in addition to their telephone sets, the turning of a simple switch, at any station wishing to use Morse, is all that is necessary to put in connection the Morse instrument instead of the telephone. The Morse instrument should be a main line sounding relay, of 150 ohms resistance, with key on same base. The battery for each station about 12 cells dry battery, which at each of any two stations would be ample to cover any total distance less than 40 miles. The cost of all the instruments, switch and battery needed for such Morse equipment at any station would not exceed \$12.

It is possible that in the future, the great telegraph companies may make large use of telephone-Morse systems in the gathering and distribution of messages. The immense number of small railway telegraph stations, about 15,000 throughout the country, maintained by the railway companies, but all acting as feeders to the Western Union Telegraph Company, serve as a very great extension of telegraph facilities to points where it would not pay expenses to maintain office for commercial purposes, but, out of 65,000 post offices in America there is still room for many thousands more of available telegraph stations where the postmaster or mistress could be the telephone attendant and telegraph operator without additional cost of maintaining the office.

TELEPHOGRAPH.

NEW YORK CITY, Sep. 19, 1894.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS
ISSUED SEPTEMBER 11, 1894.**Alarms and Signals:**

Electrical Signaling Apparatus for Railways, P. Schwenke, Zorbet, Germany. Filed April 8, 1893.
Electric Annunciator, H. C. Thomson, Boston, Mass. 525,874. Filed July 2, 1894.

Conductors, Conduits and Insulators:

Bus Bar Insulating Support, A. B. Herrick, Schenectady, N. Y., 525,708. Filed April 11, 1894.
Fastener for Electric Wires, H. C. Fricke, Pittsburg, Pa., 525,891. Filed June 14, 1894.

Consists of a spike adapted to be driven into a support, and having a jaw at its outer end adapted to be bent around the wire.

Distribution:

Electric Transformer, C. S. Bradley, Avon, N. Y., 525,699. Filed Aug. 23, 1891.

Employs two openings in the coils with an interposed web of iron; wires constituting the primary and secondary coils being threaded through the openings and united at the end to form a continuous circuit.

System of Electrical Distribution, J. F. McElroy, Lansing, Mich., 525,769. Filed Oct. 5, 1887.

Employs an electrostatic converter having its members separated by a dielectric the thickness of which causes the fall in potential.

Dynamos and Motors:

Winding for Drum Armatures in Dynamo Machines, R. Eickemeyer, Yonkers, N. Y., 525,679. Filed Feb. 9, 1893.

Armature for Dynamo Electric Machines, R. Eickemeyer, Yonkers, N. Y., 525,698. Filed Apr. 3, 1894.

An armature in which each commutated division embodies a series of complete specially formed coils which in pairs contain an equal length of wire.

Electric Fan, C. Wachtel, Newark, N. J., 525,730. Filed Jan. 17, 1893.

Relates to certain mechanical details intended to reduce the expense of construction.

Self Adjusting Brush for Dynamo Electric Machines, W. L. Bliss, Brooklyn, N. Y., 525,836. Filed Apr. 13, 1894.

Provides automatically for the constant polarity of a dynamo, notwithstanding changes or reversal of rotation.

System of Lighting and Heating Cars by Electricity, M. Moskowitz, Newark, N. J., 525,928. Filed March 31, 1894.

A system of car lighting and heating by means of a generator carried upon the axle.

Means for Equalizing Electromotive Force of Dynamos, M. Moskowitz, Newark, N. J., 525,928. Filed June 15, 1894.

Employs two electrical machines having a common shaft, one machine acting as a motor to operate the shaft and receiving its power from the generator whose electromotive force is to be kept constant, and the second machine acting as a dynamo with its armature and field so coupled with the fields of the main generator that its electromotive force will oppose that of the main circuit.

Electric Motor, J. S. Loesch, Summit Station, Pa., 525,016. Filed Feb. 6, 1894.

Employs a series of field magnets, a series of armatures, and a commutator composed of a cylindrical shell, one end of which is divided into a number of distributing sections equal to the number of armatures.

Lamps and Apparatuses:

Electric Arc Lamp, S. L. Campbell, Kalamazoo, Mich., 525,735. Filed Jan. 23, 1894.

Relates especially to the mechanical construction to facilitate taking apart and reassembling.

Electric Arc Lamp, A. B. Roney, Chicago, Ill., 525,743. Filed Feb. 7, 1894.

Employs two pairs of carbons feeding to a common centre, and electromagnetic means for forming and maintaining the arc.

Manufacture of Carbons for Electric Lamps, T. A. Edison, Menlo Park, N. J., 525,898. Filed March 30, 1890.

Claim 1 follows:

An incandescent conductor for an electric lamp formed of a carbonized natural fiber of endogenous growth and made up of parallel elementary fibres.

Incandescent Lamp Stand and Reflector, G. F. Klemm, Philadelphia, Pa., 525,909. Filed June 9, 1894.

Electric Arc Lamp, H. E. Bradley, New Bedford, Mass., 525,943. Filed Feb. 23, 1894.

Employs a cut-out comprising a spring plate secured to the lamp frame, a rod connecting the tilting lever to the spring plate, and a relatively stationary plate arranged in the path of travel of the spring plate.

Measurement:

Recording Voltmeter, F. D'A. Goold, Schenectady, N. Y., 525,894. Filed April 16, 1893.

Employs a series of levers comprising a parallel motion to which a recording surface is secured, and an operating coil and armature, the latter suspended from the lever.

Miscellaneous:

Electric Clock, F. L. Gregory, Chicago, Ill., 525,704. Filed Jan. 30, 1894.

Electrolytic Apparatus, E. Andreoli, London, Eng., 525,793. Filed Aug. 4, 1893.

Employs an anode composed of a number of single pieces of retort carbon presenting on one side flat surfaces, and a cathode opposite the smooth surfaces of the anode.

Synchronizing Mechanism for Electric Clocks, E. Ayres, Sydney, New South Wales, 525,779. Filed Oct. 7, 1893.

Manufacture of Wire Strips or the Like by Electrodeposition, R. D. Sanders, Eastbourne, Eng., 525,900. Filed Aug. 3, 1892.

Claim 1 follows:

A mandrel for the manufacture by electrodeposition of a continuous strip of metal, having a spiral groove the base of which consists of an intermediate conducting portion and of insulating portions at each side of the same, the side walls of the groove being also of insulating material.

Railways and Apparatus:

Electric Railway System, C. S. Bradley, Avon, N. Y., 525,690. Filed Jan. 2, 1894.

Claim 1 follows:

An electric system of transmitting power comprising a plurality of alternating current generators organized to impose on the line currents of different frequency, distributing lines supplied thereby, and alternating current motors adapted to be connected with any of the several distributing lines.

Combined Brake and Electric Switch for Street Railway Cars, G. Brown, Long Island City, N. Y., 525,782. Filed Jan. 20, 1894.

Provides means for automatically applying current with gradually increasing strength at the same time that the brakes are removed from the wheels.

Trolley Pole Connection, M. R. Mahon & J. M. Crane, Newark, N. J., 525,789. Filed Nov. 10, 1893.

Provides means for the lateral motion of the trolley.

Electric Railway, H. E. Rider, New York, N. Y., 525,864. Filed Feb. 26, 1894.

Relates especially to the insulation of underground conductors.

Trolley for Electric Railroads, E. Dawson; Terre Haute, Ind., 525,836. Filed Dec. 26, 1893.

Relates especially to a wire slider consisting of a pin adapted to extend above the trolley wire when the cord is tightened.

Conduit System for Electric Railways, W. G. Creighton, Chicago, Ill., 525,945. Filed Feb. 23, 1894.

Employs a slot closer adapted to rest upon a suitable support and opened only during the passage of the car.

Switches and Out-Ofs:

Lightning Arrestor, A. L. Courtright, Keokuk, Iowa, 525,840. Filed Feb. 1, 1894.

Consists of a valve which is capable of adjustment so that it may be set to operate by variation in the current from a given electromotive force.

Electric Switch, G. Baehr, Jersey City, N. J., 525,936. Filed Jan. 9, 1894.

Relates to mechanical details of construction of quick brake, jack-knife switches.

Telephones and Apparatus:

Telephone Call System, E. T. Gilliland, Pelham Manor, N. Y., 525,702. Filed Nov. 27, 1893.

Employs a resonator so arranged as to be close to the diaphragm of the telephone when the latter is upon its support.

Telephone Call System, E. T. Gilliland, Pelham Manor, N. Y., 525,708. Filed Jan. 11, 1894.

Employs a normally closed circuit including a call receiving instrument, a dip battery for transmitting calling current, and connections for opening the circuit and cutting in the battery during immersion of its electrode.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS
ISSUED SEPTEMBER 18, 1894.**Accumulators:**

Secondary Electric Battery, O. Theryo and A. Oblaser, Paris, France (Reissued) 11,442. Filed July 4, 1893.

Employs an envelope composed of perforated sheets of celluloid tightly enclosing the conductor and the active material on all sides.

Alarms and Signals:

Signal Apparatus, G. L. Thomas, Brooklyn, N. Y., and E. C. Seward, Montclair, N. J., 525,168. Filed Jan. 22, 1894.

An automatic electric block signal system for steam railways.

Signal Apparatus, J. P. Coleman, Swissvale, Pa., 525,179. Filed Dec. 2, 1893.

An electrically controlled interlocking semaphore system operated by fluid pressure.

Dial Transmitter, F. Pearce, New York and J. Broich, Brooklyn, N. Y., 525,856. Filed June 11, 1894.

Employs an arm with a finger traveling over the edges of the dials and operating a circuit breaker to interrupt electric pulsations sent progressively on the respective fire alarm circuits.

Conductors, Conduits and Insulators:

Electrical Connector, J. B. Henck, Jr., Brooklyn, N. Y., 525,078. Filed July 6, 1894.

Consists of an enclosing tube whose interior cross section is divided into two similar parts, and a contact making device attached to one of the parts and making contact with a similar piece attached to the other part.

Distribution:

Multiphase Converter, H. O. C. E. Wagemann, St. Louis, Mo., 525,063. Filed July 5, 1892.

Employs an iron body composed of two parts, a central core part with radial extensions and a separable annular encircling piece fitted to the extensions.

Dynamos and Motors:

Electric Generator, H. O. C. E. Wagemann, St. Louis, Mo., 525,064. Filed July 5, 1892.

Employs an armature with a plurality of coils producing multiphase current impulses, the inner terminals of the coils of alternate phases being connected in series and the outer terminals of two successive coils connected in multiple.

Electric Motor, E. Thomson, Lynn, Mass., 525,169. Filed Aug. 30, 1894.

The invention relates to a stopping switch and devices responding to changes in speed for controlling a detent whereby the switch is made to cut off the current at a predetermined increasing speed.

Electric Motor, A. W. Weston, St. Louis, Mo., 525,063. Filed Aug. 1, 1892.

Claim 1 follows:

In an electric motor, the combination with the armature, of one or more coils wound on the armature in a plane parallel to the plane of the magnetic lines of force, and means for throwing the said coil or coils, into the motor circuit.

Dynamo Electric Machine, D. H. Wilson, Chicago, Ill., 525,170. Filed Aug. 17, 1893.

Combines in one machine a motor and generator whose armatures are fastened to the same shaft and whose field magnets are magnetically connected but electrically separated.

Lamps and Apparatuses:

Incandescent Electric Lamp, D. J. Cartwright, Boston, Mass., 525,145. Filed Jan. 27, 1894.

The invention consists of a socket adapted to the use of any one of the leading types of incandescent lamps.

Measurement:

Electric Indicator, C. J. Coleman, Chicago, Ill., 525,220. Filed Dec. 8, 1893.

Employs a standard cell, a measuring instrument, a variable resistance and a resistance varying device consisting of a column of mercury moving in constant contact and parallel relation with the variable resistance when affected by heat or pressure, to reciprocally vary the degree of such resistance.

Miscellaneous:

Apparatus for and Process of Extracting Gold or Silver from Ores, P. Danckwardt, New York, 525,099. Filed April 2, 1894.

The process consists in subjecting gold and silver ores simultaneously to action of cyanide of potassium, an alkali sulphide and to electrolysis.

Process of Electrodeposition of Chromium, E. Placet and J. Bonnet, Paris, France, 525,114. Filed Aug. 20, 1893.

The process consists in passing an electric current through an electrolytic bath composed of a soluble chromic compound in aqueous solution.

Pneumatic Tube Fisher, W. C. Bloomer, Brooklyn, N. Y., 525,141. Filed April 10, 1893.

Art of Plating one Material with another, T. A. Edison, Menlo Park, N. J., 525,147. Filed Jan. 23, 1894.

The process consists in supporting the body to be coated in an exhausted chamber, supporting electrodes of different conducting materials in the same chamber, and maintaining an arc between the dissimilar electrodes.

Galvanic Chain, F. Fritzsche, Berlin, Germany, 525,182. Filed May 12, 1894.

An "electric belt."

Railways and Appliances:—

Bond for Electric Railways, D. D. Book, Brooklyn, N. Y., 526,142. Filed July 14, 1894.

Claim 1 follows:—

A rail bond for electrical railways comprising a bond plate electrically connected with the rail provided with upwardly extending holes to facilitate connection with the bond conductor.

Trolley Wire Finder, E. Gale, Peoria, Ill., 526,153. Filed Nov. 21, 1892.

A lever pivoted upon the axis of the trolley wheel and operated by drawing down the trolley cord.

Switches and Cut-Outs:—

Electric Switch, L. Winterhalter, Milford, Conn., 526,172. Filed Feb. 17, 1894.

Claim 1 follows:—

In an electric switch the combination with the contact clamp of a U shaped spring having bearings on opposite sides of said clamp.

Electric Cut-Out, E. E. Hersh, Denver, Colo., 526,227. Filed Mch. 7, 1894.

Telephones and Apparatus:—

Telephone Transmitter, H. L. Baldwin, Chicago, Ill., 526,139. Filed Jan. 30, 1892.

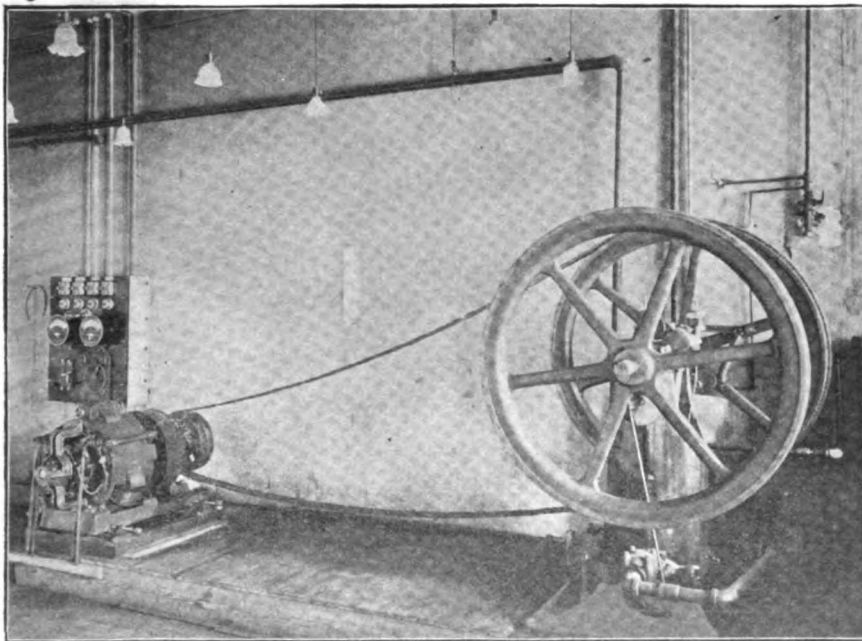
Employs a horizontal bar electrode mounted upon the diaphragm and a series of depending arms having the centre of gravity so located that each of the electrodes will tend to move beyond a vertical line through the point of suspension.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

GAS ENGINES FOR ELECTRIC LIGHTING.

THE most severe test to which any gas engine can be put, is in an incandescent electric light plant, where a uniform speed of the engine is essential to the proper working of the system. The



GAS ENGINE ELECTRIC LIGHTING PLANT.

highest grade steam engine in the market to day, with multiple expansion, condensers, feed water heaters, etc., will only convert about ten per cent. of the energy of the fuel into work; while the average gas engine will convert from twelve to fifteen per cent., and the best make, about twenty five per cent.

If we take a steam engine and a gas engine, each having the same diameter of cylinder, and stroke of piston, it is a well known fact that, both going at the same speed, the latter will produce about twenty five per cent. more power while at the same time utilizing less fuel; this is due to the high pressure attainable in the gas engine cylinder. On an average the smaller sizes consume about 20 cubic feet of gas per horse power per hour, and in the larger sizes about 15 cubic feet are consumed.

Numerous tests have been made which show conclusively that a given amount of gas, consumed in a gas engine driving a dynamo supplying incandescent lights, will produce three times the light or illumination obtainable from the same quantity of gas consumed in the usual way; that is to say, the amount of gas consumed in three ordinary gas burners for one hour is equivalent to that used to produce ten full sixteen candle incandescent electric lights, for one hour.

The largest gas engine plant in this country is of 300 H. P. capacity and is used for central station electric lighting. In

England gas engines as high as 500 H. P. are in use. The accompanying illustration shows a gas engine electric light plant in daily operation in this city. The lights remain absolutely steady under all conditions; and the voltmeter does not fluctuate one volt from one lamp up to full load.

A steam engine of the same dimensions, as the one here shown, would be known in the trade as being of six horse-power capacity but this develops much more power. It is designed to maintain sixty 110 volt, $\frac{1}{2}$ ampere 16 candle lamps at normal full load, although it will maintain 67 lamps for any length of time. The dynamo runs at 700 revolutions.

This radical improvement is the result of the combined efforts of two prominent inventors of this city.

Mr. Edward Durant, Electrical Engineer, of 39 Cortlandt St., T. Y., will be pleased to show this system running at any time.

THE FALK TROLLEY WHEEL.

THE accompanying illustration gives an excellent view of the Falk trolley wheel and harp, which is being offered to street railway people by the Central Electric Company. W. R. Garton, in charge of their street railway department considers this a great improvement over other styles of wheels which use graphite or roller bearings. The Falk trolley is constructed with cone bearings, so arranged that they adjust themselves automatically to the slight wear. The wheel is at all times kept in a perfectly true position so that while it is allowed to revolve with entire freedom, it never rattles or wobbles. An important feature is the "dope" chamber inside the wheel. This carries sufficient lubricant for many miles of travel. No grease or oil is wasted by dripping or



THE FALK TROLLEY WHEEL.

leaking. All removable parts are secured by steel cotter-pins so that they can not work loose. The Central Electric Company has some new literature in preparation describing improved railway devices. These circulars will be mailed to everyone interested.

WARREN & LOZIER.

The above firm composed of A. K. Warren and R. T. Lozier, have succeeded to the business of The New York Electrical Repair Co., and are now very busy at their shops, 465 Greenwich street, where they have increased both their floor space and their equipment, as well as their working force. They undertake construction and repairs, and furnish supplies of any kind in any quantity. Mr. Lozier has had a long and arduous training in the electrical field, and finds in his partner a kindred spirit—young, active and progressive. It is to be hoped and expected that they will secure a large share of the isolated plant and motor work in New York city and vicinity.

THE BERLIN IRON BRIDGE CO., of East Berlin, Conn., is putting up a gas house roof for the New Jersey Gas & Construction Co., at South Amboy, N. J.

WOONSOCKET ELECTRIC CO.'S NEW WATER POWER PLANT.

WHEN the Woonsocket, R. I., Electric Machine and Power Company purchased the Harris mill property on Main street, it was at once conceded to be a valuable addition to the company's holdings of real estate, as, aside from its value as a desirable piece of property, it could be utilized by the company in the extension of its electric plant, thus relieving the Front street station and concentrating its street railway electrical plant in a location that would require less wire erection than would be the case if power were furnished from the Front street station.

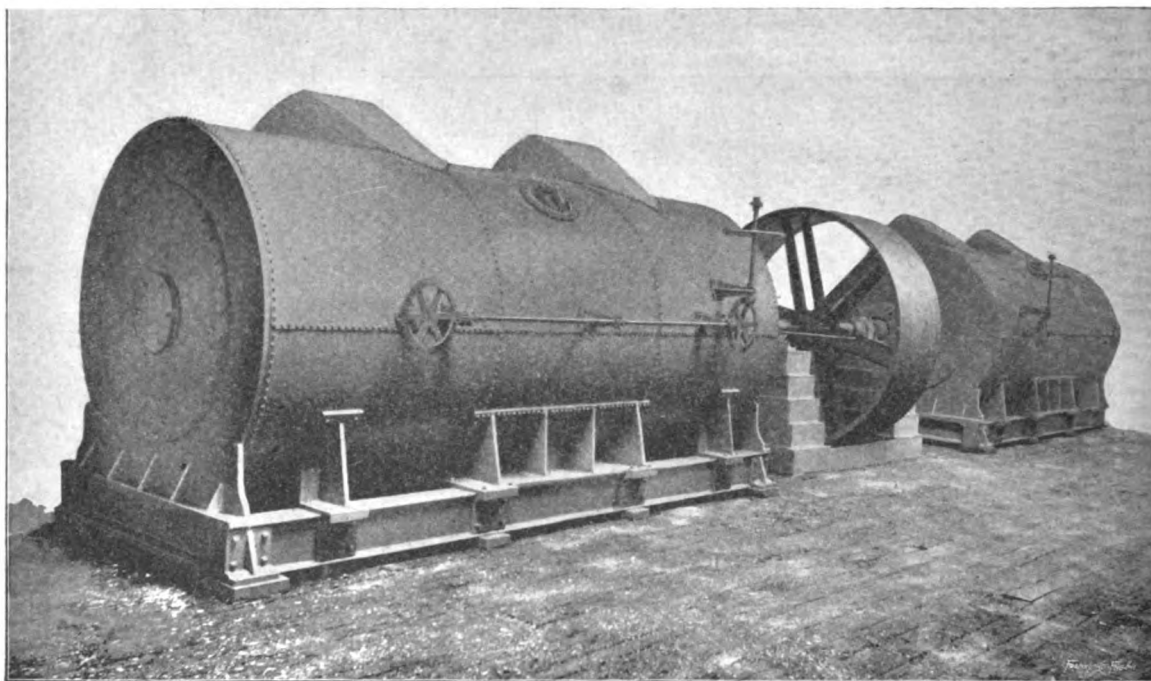
The old apparatus used in utilizing the water power belonging to the estate has been replaced by new bulkhead gates, apron racks, and waste ways, and the installation of the powerful water wheels illustrated in the accompanying engraving. The old bulkhead gates and the attendant racks, etc., have disappeared and in their place we find substantial hard pine framing and modern gates five and one half inches in thickness raised and lowered by an ingenious leverage arrangement requiring but little expenditure of strength in the operation. The feeder tubes to the wheels are circular in form and come through the solid frame and plank to the gates themselves. From here the water passes through the feeder tubes to the power plant, which consists of two pairs of 36-inch cylinder gate Victor turbines, on horizontal shaft, operating under seventeen feet working head and developing 600 horse power.

pattern self-oiling swivel boxes. Connecting each end of the shaft which carries the large driving pulley with the shaft from each pair of turbines is a Worrell friction clutch coupling, so that the pulley may be driven with either or both pair of turbines.

Throughout the entire power plant, while none of the good points that experience and mechanical skill could give have been omitted, simplicity and strength are prominent features, and the Woonsocket Electric Machine and Power Company, as well as the builders, the Stilwell-Bierce & Smith-Vaile Company of Dayton, Ohio, are to be congratulated, for what is as perfect a water power plant as can be found in New England.

On the floor above the wheels, running parallel with the front of the building, is a heavy line of 6-inch shafting with a receiving pulley with 51½ inches face and 64 inches in diameter connected with the wheel shaft by a three-ply belt, 50 inches in width. To the left of the receiving pulley are three driving pulleys, each 69 inches in diameter, and 15½ inches face, each operated by a Worrell or Laconia friction clutch. These pulleys are for driving the power generators, which are connected by 15 inch three-ply belts. These generators are installed on massive brick and stone foundations reaching to solid ground ten feet below the water line. To the right of the receiving pulley is another pulley 69 inches in diameter with a 15 inch face, operated, as are the others, by a Laconia clutch, which will be used to transmit power to the rooms above as they may be leased for manufacturing purposes.

The three generators placed in this mill will be used in con-



VICTOR TURBINES IN THE WOONSOCKET ELECTRIC CO.'S NEW WATER POWER PLANT.

Each pair of turbines is mounted in a separate wrought-iron flume, which rests on double steel I-beams, which are supported at either end by the wheel pit walls. The water is conveyed to these flumes, from the forebay outside of the building, by means of two wrought-iron feeder pipes which enter the flume nearly over each turbine. Each feeder pipe is supplied with a head gate, by which the water can be entirely shut out of the flumes in case it is found necessary to enter for examination or repairs. The flumes are also supplied with a cover at each end, which can be removed, leaving an opening large enough to remove any part of the turbines if it is ever found necessary to do so from accident or other cause.

Each pair of turbines discharge into one draft tube, and with this arrangement, the two turbines discharging towards each other, no steps are required when both turbines are running, as all the end thrust is balanced; but as the gates of these turbines are arranged so that one turbine of each pair, or one pair and one turbine of the other pair may be run, steps have been supplied. Each pair of turbines has a governor for regulating the speed. These governors and the hand wheels for operating the gates are located on the floor above the wheel room.

Midway between the two flumes is the main driving pulley, which is 11 feet in diameter, with width of face sufficient for a belt 48 inches wide. The speed of the turbine shaft is 133 revolutions per minute, and with a pulley of above diameter, a belt speed of 4,595 feet per minute is obtained. This pulley is keyed to a steel shaft 7¾ inches in diameter, which runs in the latest

junction with another very powerful generator to be located in the Front street station, to transmit the water power from this plant, when not in use, or only partially to the Front street station, where it will be utilized, thus making a great saving of fuel over the present consumption.

EXHAUST STEAM HEATING.

THE Dunkirk & Fredonia Electric Railway Company is constructing an underground steam plant, by which they propose to heat the State Normal School building, in Fredonia, the Union Free School building, and many other business houses and dwellings. Exhaust steam will do the work, supplemented by live steam as occasion may require. The work of construction is being done by the American District Steam Company, of Lockport, N. Y.

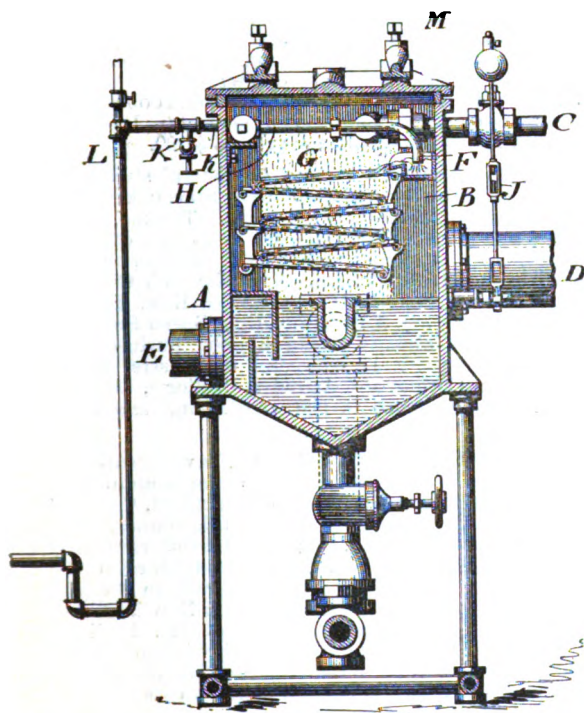
REVIVAL OF TRADE.

The Mather Electric Company, of Manchester, Ct., report as a sign of the revival in the electrical business, the closing in three consecutive days last week of contracts for more than 1,500 horse power of their standard apparatus, consisting of direct connected and belted generators and their Manchester type slow speed motors. This with the other work the Mather Company now have on hand will compel them to at once increase their working force, although part of their works is now being operated at night.

THE WEBSTER FEED WATER HEATER AND PURIFIER.

It has been found with many of the feed water heaters and purifiers in ordinary use, that at certain times when the supply of steam is limited and insufficient in volume to heat the inflowing water to the highest temperature, the air which is expelled from the water accumulates in the top of the heating and purifying chamber, and renders the device inoperative until the air is removed, thus requiring a pressure of steam to enter the chamber at intervals at a pressure in excess of that of the atmosphere, so as to expel the air through the overflow or relief pipe, and thus make room for the steam. In order to obviate the necessity of requiring steam to enter at a pressure in excess of that of the atmosphere, and to get rid of the air as rapidly as it is liberated from the water, and also to be able to use steam at a pressure less than that of the atmosphere by maintaining a partial vacuum within the feed water heater, Mr. Warren Webster, of Merchantville, N. J., has devised the apparatus shown in the accompanying illustration.

In carrying out his invention Mr. Webster employs a suction device, positive in its action, and capable of being operated at will, independently of any other discharging pipe, and connecting with a pipe communicating with the inside of the chamber above the water line, so as to obtain the amount of suction necessary to



WEBSTER FEED WATER HEATER AND PURIFIER.

withdraw the air, and maintain a partial vacuum within the heater if desired. The device contains a chamber B with a water supply C, a steam inlet D, an outboard water delivery pipe E, a spraying device F, metal distributing plates G, condensing tubes H and gravity regulator J.

Connected with the chamber B, and communicating with its interior, is an air pipe K, having an automatic air inlet valve K'. To this pipe is attached the suction device L in the form of air injector by means of which the air is withdrawn from the chamber B and the heater and purifier is thus set in operation.

STANDARD ELECTRIC CO., OF PHILADELPHIA, RECEIVERSHIP.

JAMES F. McLAUGHLIN has filed a bill in equity asking for the appointment of a receiver for the Standard Electric Company, of 2248 North Ninth street, Philadelphia. The defendants in the bill are Robert E. and James W. Diffenderfer and T. H. Gebley. It is averred that the defendants, without the complainant's knowledge or consent caused the removal of all the machinery, including that owned by him, from the workshop to a storage house, and notified Mr. McLaughlin that they did not intend to carry on any further business under the terms of the partnership agreement. In consequence of this the business has been wholly abandoned.

BLOCK LIGHTING IN NEW YORK.

The Block Lighting and Power Company No. 1 has been recently incorporated in this city with \$50,000 capital stock. It is the intention of the company to install separate isolated plants one in each city block for the purpose of supplying all the buildings of that block with current for light or power purposes. From a central distributing pole wires will radiate to premises of the several consumers. It will then be unnecessary to maintain subways and the expense of light and power will, it is thought, be materially lessened.

The directors of the company are Robert Stafford, Albert M. Palmer, Edward Lauterbach, and Thomas B. Robertson.

THE TURNBULL INCANDESCENT LAMP.

The accompanying illustrations show an incandescent lamp devised by Mr. J. W. Turnbull, of New Orleans. Fig. 1 is a half size sectional view of a 32 C. P. lamp, while Fig. 2 shows the bulb and the stopper in detail.

The bulb is molded to an exact finish with ground sockets to fit the stopper b. The sockets are ground by a tool the exact counterpart of the stopper which grinds both of the sockets with the same movement and at the same time, thus securing a perfect fit between the stopper and the bulb.

Within the stopper is a glass tube c, silvered on the inside and

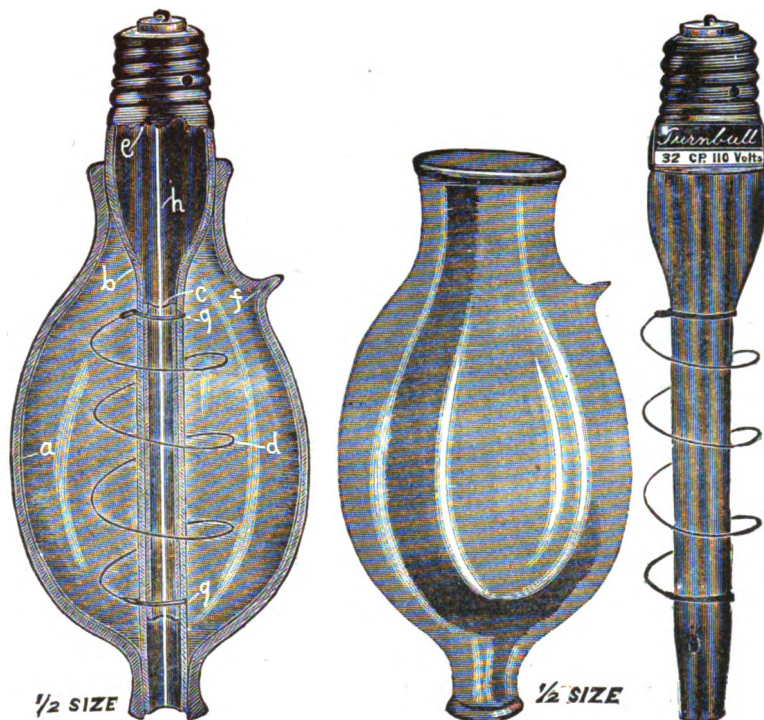


FIG. 1 AND 2.—TURNBULL INCANDESCENT LAMP.

acting as a reflector. The carbon may be either coiled or straight and is supported on collars as shown at g, and the base e is either sealed or sprung on the end of stopper. After the space between the tube and the bulb has been exhausted, the seal f is left long enough to admit of its end being easily opened to refill the vacuum chamber with air, so as to remove the stopper when necessary, to put in a new carbon or repair the lamp. The collars g that support the carbon are electrically connected with the base of the lamp by means of the wire h and a metallic grease or paint, the latter acting as a conductor and dispensing with leading-in wires.

A NEAT BATTERY RESISTANCE SWITCH.

THE PUMPELLY-SORLEY STORAGE BATTERY COMPANY, Chicago, have recently gotten out a neat resistance switch which they furnish with their galvano-cautery batteries. The resistance wire is arranged in the form of a continuous spiral, partly embedded in slate, porcelain or other insulating material. The two terminals of the wire are connected to two binding posts, the contact lever and one of the spiral ends being connected to another pair of posts. The upper edge of the spiral is slightly flattened so as to make good contact with the lever. The switch has no connecting wires of any kind, is very simple, and by means of it, the current can be modified to any desired degree within the range of the resistance.

AN "AJAX" 7000 AMPERE SWITCH.

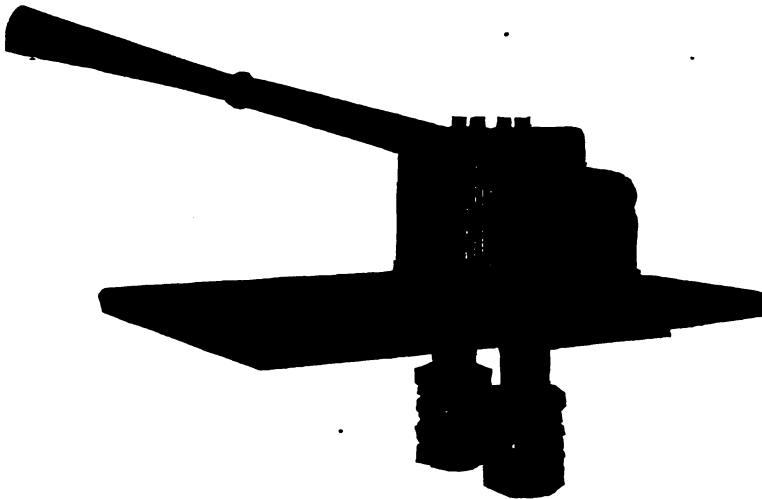
As late as April, 1898, a switch guaranteed to successfully rupture a circuit carrying 8000 amperes of current, at a potential of 500 volts, was considered a giant in breaking capacity. During the interim, Ajax switches have been designed for 4500 amperes (fifty per cent. larger than any attempted before), and several such are in actual service on street railway circuits.

We are now enabled to illustrate another advance in switches: the switch in the cut representing a new "plunger type" Ajax switch of 7000 amperes capacity. This switch is guaranteed to break its full rated capacity at 500 volts potential, or nearly 4700 H. P. It was ordered by the Electric Traction Company of Philadelphia, through the General Electric Company, who are building the switch-board for their new Delaware avenue power house.

Except the carrier and stand, which do not form any part of the circuit, the entire switch is made of commercially pure copper, and provision is made for clamping direct to a laminated bus-bar, consisting of six bars, each $5'' \times \frac{1}{4}''$, or a total of $7\frac{1}{2}''$ sectional area; which is also the minimum of sectional area in any part of the switch.

The contact area, finish and action are of the well known Ajax formula. The switch is compact in form and occupies a space only $14'' \times 18''$ on the switch-board.

A handle of unusual length is required to operate these large and close fitting blades, which overhangs the switch proper, several inches; the total length of the handle from the pivot is $41\frac{1}{2}''$, and terminates in a highly polished piece of old mahogany.



"AJAX" 7000 AMPERE SWITCH.

As a continuous current circuit breaker, it is believed the subject of this sketch is the largest yet attempted. It is needless to say that it has not yet been tested to its limit. These switches are the manufacture of Mr. C. S. Van Nuis, 136 Liberty street, New York City.

THE PHOENIX CARBON MFG. CO.

Mr. S. G. Booker, well-known from his prominent connection with the Fidelity Carbon Co. up to the time of its absorption, has now organized the Phoenix Carbon Mfg. Co., of 2,134 to 2,140 De Kalb street, St. Louis, which has begun the manufacture of electric light carbons and other carbon specialties. The Company is incorporated for \$100,000, and has some of the best people in St. Louis in it. Mr. Booker is a man of great ability, resource, energy and enterprise, and as he proposes to carry on this business "free from entangling alliances," his new departure is watched with interest and goodwill by local companies in all parts of the country.

NEW SIEMENS & HALSKE CATALOGUES.

The Siemens & Halske Electric Co. have just issued two new catalogues illustrating two types of their generators and motors. The first describes the bipolar type L. H. machines with upright field magnets and embodying the most approved principles of construction. The commutator bars on these machines are detachable and zinc shields are used in place of canvas to cover the heads of the armature. These zinc covers can be readily removed and thus admit of inspection at any time.

The generators and motors of Type I described in the second catalogue have internal pole pieces. The field magnets of these machines, numbering from four to twelve, according to the size of the machine, are placed inside of the Gramme ring. This construction, by permitting a large increase of the diameter of the

armature, results in a greater peripheral velocity with a given number of revolutions of the shaft. These machines are built for belt driving as well as for direct connection to engines. The catalogues contain long lists of the Siemens & Halske machines now in operation in the United States, the installations ranging from a few horse power up to 2,100 H. P. employed in railway station work.

NEW ENGLAND NOTES.

THE IONA MANUFACTURING Co., of 836 Congress street, Boston, has issued a well printed and profusely illustrated catalogue of electric lighting specialties, including sockets, switches, cut-outs, etc.

H. N. BATES & Co., of Boston and New York, have just issued a handsome and useful new catalogue of friction clutches, gears, pulleys, cut off couplings and their other well known specialties for electric light plants, mills, factories, machine shops, etc. It is profusely illustrated, full details as to sizes, weights, etc. are given, and the prices are very moderate. We recommend our readers to write to Congress street Boston or to 126 Liberty street, New York, for a copy.

"STANDARD WIRING." Mr. H. C. Cushing, Jr., electrical inspector for the Boston Board of Fire Underwriters, has just published a small book under the above title, which should prove invaluable to all electricians, contractors and electrical engineers. It contains twenty illustrations of the newest methods of inside and outside construction for direct and alternating current wiring, together with all the necessary tables, rules and formulae, as approved by the insurance inspectors throughout the country. The book has been carefully prepared by one who knows the subject thoroughly, and is in convenient form, and should commend itself to all interested in electrical engineering projects. It can be procured only from Mr. Cushing and the price is \$1.00.

THE HANCOCK EQUIPMENT Co., of 41 Federal street, Boston, are having a large success with their new Starbuck fan, which they have recently introduced to the trade. The fan is built on new principles and is materially different from any other fan on the market, and can be driven either from belting, or supplied with an electric motor attachment. The Hancock Co. are also agents for the Stearns Manufacturing Co., of Erie, Pa., manufacturers of the Woodbury Automatic High Speed Engines, and steam boilers, and are already doing a good business in these specialties. The company is composed of Messrs. Frank B. Witherbee, Chas. A. Cotton, and Alfred S. Kellogg, all of whom have had a long experience in the ventilating and electrical business.

THE PETTINGELL-ANDREWS Co. of Boston, have recently become sole selling agents in the United States for the commutator bars manufactured by Billings & Spencer of Hartford, Conn. They have also become sole selling agents in this country for Dick, Kerr & Co., of London, England, large manufacturers of steel rails for electric and steam power railroads. The business of the Pettingell-Andrews Co. has largely increased within the past few months and they have now opened an office in New York at 39-41 Cortlandt street, under the management of Mr. F. X. Cicott. Their new store in Boston is now thoroughly equipped and furnished, and is second to none in the East, and has already become an electrical "rendez-vous" in Boston, owing to its central location, and attractive and roomy appearance.

THE W. S. HILL ELECTRIC Co. are at present finishing a handsome switchboard for the new Castle Square Theatre in Boston. It is of the convertible type, being adapted for using the current either from the theatre's own plant, or from the street circuits, in case of break down. The board is of 2' slate, is 16 feet long and stands $7\frac{1}{2}$ feet high. On the front of the board are two 4-pole 1,000 ampere switches, one 3-pole 1,000 ampere switch and one 4-pole 300 ampere switch, all used for the dynamo circuits. The feeder circuits are supplied with two 3-pole 800 ampere switches, and six 3-pole 200 ampere switches. The bus bars and equalizers are all on the back of the board, and nothing appears on the front but the switches, volt and ammeters, and field switches. The board is finished in the usual first-class style of the Hill Co., and is an extremely handsome, as well as substantial, piece of work. The Hill Co. are also manufacturing an arc and incandescent board for the Attleboro Electric Light Co., of Attleboro, Mass., and an incandescent board for J. S. Potter, of Boston, for the Morse Twist Drill Co., of New Bedford. Altogether the Hill Co. are busy and are turning out large quantities of their high grade switches for the general market.

Departmental Items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE Electrical Engineer.

Vol. XVIII.

OCTOBER 3, 1894.

No. 335.

HOW THE CARBON BRUSH CAME INTO USE.

BY

Edwin Thomson



It is, I think, true that no single thing has had a greater or more direct influence upon the technical success of electric railway machinery than the introduction of the carbon brush as a substitute for the various forms of metal brush, many forms of which had been tried previously on railway motor commutators but without even the beginning of success. Simple as this substitution was, the results are of the greatest importance. The pioneers in electric railway work had been struggling with the many problems presented, not the least of which was to get a motor commutator to run under varying loads without spark, to run in either direction without trouble, and without need of changing the lead, and above all to endure for a reasonable time.

All forms of metal brush had been tried and become acknowledged failures. They were only calculated, under the harsh conditions, to be ground and to grind the commutator into dust at a rapid rate, (such dust being scattered by the pound along the line of way) with the production at the same time of a flickering greenish illumination under the car, an illumination all the more ghastly on account of the havoc known to be going on and of which it was an unfailing index. It is not too much to say that before the carbon brush was substituted there was in prospect inevitable failure; disaster not unforeseen, but all too evident.

But after the advent of carbon all this was changed, and a great load was at once lifted from the shoulders of those on whom rested the responsibility for the success of the apparatus then being applied to street railway work. Failure from technical difficulties was not to be thought of more. The great bugbear and most annoying obstacle had been overcome, and overcome as it were, in a day.

But how did it come about? I do not know that the circumstances have ever been detailed in print, and it shall be my present purpose to fill this gap in the history of electric railways and at the same time to pay a tribute to the memory of Mr. Chas. J. Van Depoele, truly a pioneer in this art and to whom was due the suggestion of the use of carbon as a brush for railway motors.

It came about in this way. We had been trying to use on the first roads installed by the Thomson-Houston Co. in 1888, various forms of copper and other metal brushes, all of which, however, had soon been condemned as either quite worthless for the purpose or so nearly worthless as practically to be so. A discussion of the matter between Mr. Van Depoele and myself, attended as it was by many expressions of misgiving as to the fate of electric railway work unless a radical change for the better could soon be made in the commutators, led him to remark in substance: "I have used a plate of carbon as a brush, on a stationary

motor, which carbon brush worked well, and I think it might answer the purpose here." To this I replied, in effect, that if such was the case we should by all means make the trial at once, as, if it should fail, that would be an event to which we had become somewhat accustomed in our experiments with metal brushes.

The trial was made and was at once so eminently successful that scarcely any time elapsed before the metal brush became a thing of the past, not only on the Thomson-Houston railway motor apparatus, but on others also, as soon as the news got abroad. We called the new brushes "carbon brushes," though of course they have very little of the *brush* proper about them. In some other systems they were dubbed "graphite brushes," and their merits were set out in a sort of "I told you so" spirit; for the carbon brush was copied in substance, if not in name. They are all "carbon" to-day.

It was some little time after the introduction of the carbon brush on the motors that the same substitution was made on the generators. This was, I think, first done on the Thomson-Houston D 62 type generator. It had been soon found that with the great variations of load occurring, very serious effects of sparking and cutting of the commutators of the power generators was brought about. The rapidly changing lead made it impossible to make suitable adjustments of the brushes. Carbon, however, as with the motors, solved the difficulty and their use on the power dynamos was a natural consequence of their application to the motors.

I remember inspecting one of the first carbon brushes applied in railway work to a motor commutator after it had had a reputed run of 5,000 miles. It had only worn down to a moderate extent and the commutator retained its smooth black polish. Then it was that we knew that the difficulty, at one time so serious and exasperating, had been removed and our reputations as skilful electrical engineers saved for the time.

The first proposal to use carbon as a current collecting brush for dynamos was made by Prof. George Forbes, in a British patent of 1883. Blocks of graphite were to be applied in his unipolar machine to collect the currents developed in the revolving iron armature and the patent further suggested the use of such blocks on ordinary multiple segment commutators. For unipolar work their resistance would make them of doubtful utility in view of the low potential generated and the large currents, and even for low pressure lighting dynamos they are scarcely suitable; but for power work at 500 volts, whether for generators, stationary motors or railway motors, their introduction was a great step in advance.

The whole matter seems now so simple that it is hard to realize the state of things which existed immediately before the happy suggestion of Mr. Van Depoele was put into practice. And the state of things thereafter is indicated by the rapid growth which followed and which has continued to the present. Technical success must be assured before business success can be based thereon, and I feel sure that in the above brief account I have not overestimated the effect or value of one of the small yet great things that have contributed to that success.

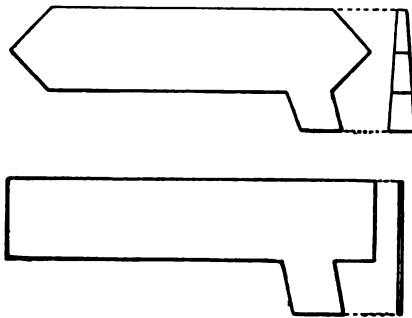
ELECTRICAL MACHINIST PRACTICE.—III.

BY

James F. Hobart,

Before proceeding to complete the connections between commutator and armature winding, it may be well to examine some of the methods now in use for constructing commutators. Formerly, commutators were cut out of a solid ring which was first turned up to the shape and size required, then the segments were cut off with a small thin circular cutter or mill. This way is too expensive for commercial work, and is only used at present when a single commutator of odd size is wanted for experimental work, or for repairs. For practical work, all commutator segments are drop-forged and require no dressing upon the sides and edges before being put in place with insulating material between them. The segment shown by Fig. 9, is for a railroad motor, and 64 of these segments are required to complete the circle. Fig. 10 shows the insulation. Very little mica is used in commutators for railroad work. In its stead, a made-up product, called "micanite," is used. This material is built up of small waste pieces of mica, cemented with shellac.

A simple method of setting up a commutator is shown in Fig. 11. A stout arbor, *a*, is fitted into the cast iron shape *b*, which is turned to the exact size of the inside of the commutator. The arbor is set up on end, the casting



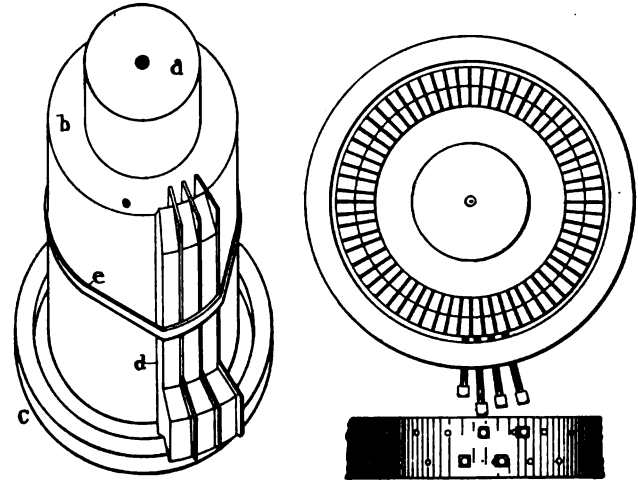
FIGS. 9 AND 10.

resting upon the bench and the lower end of the arbor passing through a hole in the wood work. A ring, or hook *c* is laid upon the bench, and the segments are set up around the casting, as shown at *d*. A rubber band *e* holds the segments and insulator until they have all been put in place.

A ring, containing 64 radially inserted set screws is then slipped over the commutator, as shown by Fig. 12. The rubber band is removed, and all the set screws gradually tightened until the segments have all been brought to a firm bearing upon the cast-iron centre. Frequent driving down of some of the segments is required in order to make them all come to a bearing. Before the set screws are tightened home, the segments must be brought parallel with the axis of the commutator, or, in other words, they must be stood up straight. If care is not taken in this direction, the commutator will be twisted when finished. This can be avoided by carefully squaring up the segments before tightening the set screws.

Pieces of the mica sometimes slip away from the cast-iron centre, leaving little channels between the commutator segments. Such spaces should always be avoided, as they tend to make sparking possible between the segments. Copper dust gathers in these, or little bits of the segments get melted off and form a connection between two of the bars, making a most aggravating short circuit, which must be found and removed before the commutator will pass muster.

The tool shown in Fig. 13 must be used to force the insulation into place. The edge of the tool is made square, and just wide enough to fit between two of the segments. By screwing the segments up pretty tight before driving the insulator into place, the mica will stand forcing with the tool, but if the segments are loose and slack



FIGS. 11 AND 12.

the first blow of the hammer may drive the tool into the mica, injuring, if not spoiling, that piece. As soon as the set screws are all tight, the mica in place, and the segments square, the commutator is ready for the lathe. The thickness of segments and insulation must be so nicely adjusted that they fit tightly to each other, and still squeeze the arbor hard enough to hold without slipping during the operation of turning. If the segments do not become tight, some thin slips of mica must be inserted between them. If, on other hand, the arbor is loose, some flakes must be peeled off of some of the mica insulation.

An improvement could be made in the apparatus for setting up the commutator. With the present device it is an almost endless "pottering" job to get each segment into place, and frequently some of the screws have to be tightened, slacked, and retightened several times. Something that can be operated more quickly than the ring with 64 set screws, is needed. After being set up, the commutator is put into a lathe provided with a compound rest with a graduated limb. The back, or "connection," end of the commutator is turned up first, then the arbor is reversed in the lathe, and the correct length of commutator may be readily laid off, as shown in Fig. 14. A well finished surface bar of iron, *b*, is laid across the back end of the commutator. A surface gauge is then applied

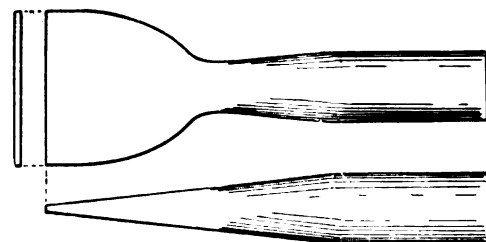


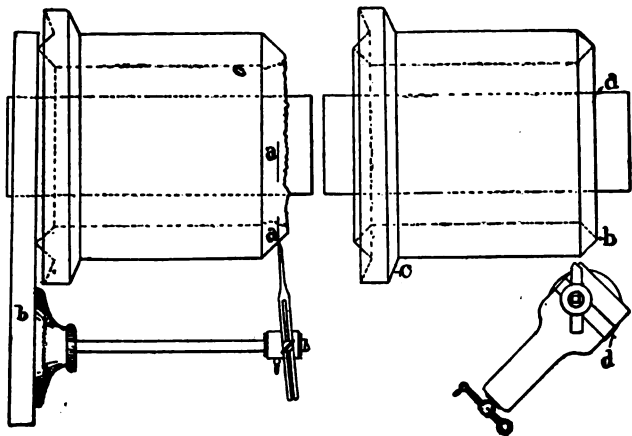
FIG. 13.

as shown, and the desired length quickly laid off, as seen at *a*. Some black grease rubbed off of the lathe back gear on the thumb, and daubed on the bright copper where the line is to be scratched, will make the mark show finely.

It is best to turn the commutator squarely off right up to the mark *a*, then turn the bevels afterwards. The

length having been determined, and turned up, the next step is to locate the point *b*, Fig. 15, which is the apex of the cone formed by the collar seat of the commutator. To locate this point set a pair of callipers to one half the diameter of the commutator at that point, *plus* one half the diameter of the arbor, then the callipers can be applied at *a b*, and the outside surface of the cone turned off boldly up to point *b*.

The angles of the collar seat are determined altogether by the graduated limb *d*, on the compound rest. This is



FIGS. 14 AND 15.

set to 45 degrees, as shown in the engraving, and the tool is fed across several times until the point *b* is reached, when the compound rest is shifted 90 degrees, and the inner side of the collar seat is faced up. An ordinary pointed "brass" tool will make the roughing cuts, and a good sharp side tool gives a good finishing cut. The angles on back end of the commutator are cut in a similar manner. The connection lug is faced up to an angle of 70 degrees, both inside and outside. After the finishing cut, the corners and angles are smoothed down a little with No. 2 sand-paper, after which the commutator is ready for its internal insulation, and the necessary collars. Immediately after the insulation and internal bushings have been put in place—and this should be preceded by a rigid examination of the interior of the commutator to see if any bit of metal has become imbedded in the mica insulation—the commutator is tested all around with a magneto wound to ring through 30,000 ohms at least.

After inspection and tests have demonstrated that the commutator is well insulated, the outside is turned off and the connection lugs drilled and tapped. This is a tedious operation, as copper is a bad metal to drill, and a worse one to tap. Numerous taps and drills are broken in this work, let the men be as careful as they can, and some commutator segment makers have grooved in, and riveted a bit of brass to the segment, to receive the connection screw; this makes a rather costly segment, but a good one. Electric welding might be employed to advantage in putting soft brass connection lugs on hard copper commutator segments.

It is stated, that the commutators thus made in private shops, cost about \$10.00, against \$45.00, the price asked by the large factories.

ELECTRIC RAMS FOR HEAVY GUNS.

AN electric ram for heavy guns, intended to take the place of the hydraulic ram now in ordinary use has been invented by Ensign Strauss, U. S. N., of the Naval Bureau of Ordnance. The ram is arranged to operate by a series of screws instead of the telescopic method of the hydraulic ram. It is said that equal speed can be obtained by using electricity for the operation of these screws, and that greater positiveness of action is insured.

MAGNETIC LEAKAGE IN DYNAMO-ELECTRIC MACHINERY.—IV.

BY

Alfred E. Whience.

c. Relative Permeance between Polepieces and Yoke. (P_4).

According to the general principle of calculating relative permeances, the magnetic potential between polepieces and yoke is to be taken $= \frac{1}{2}$, with reference to the potential between two polepieces of opposite polarity. For the yokes serve to join two magnet-cores in series, magnetically, and are therefore separated from the polepieces by but one magnet-core. If the yokes join the magnets in parallel, then they usually serve as polepieces also, and must be considered as such in leakage calculations.

Since the amounts of the leakages in the various paths are proportional to their permeances, in dynamos having an external iron surface near the polepieces, most of the leakage takes place between the polepieces through that external surface; and in such machines the leakage from the polepieces to the yoke is comparatively small.

a Polepieces having an external iron surface opposite them.

1. Upright Horseshoe Type.

From the polepiece-area, facing the yoke, *A*, Fig. 34, the leakage takes place in a straight line equal in length to that of the magnet cores, while from the end surfaces the leakage paths are quadrants joined by straight lines:

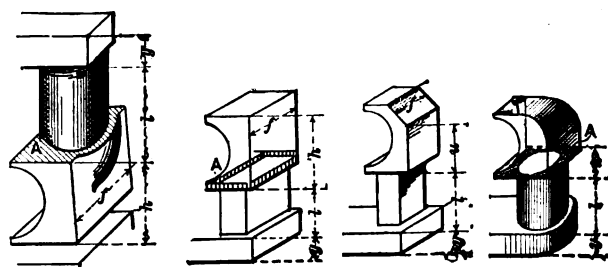
$$P_4 = \frac{A}{l} + \frac{1}{2} \left[\frac{f \times h}{l + (h + y) \frac{\pi}{2}} \right] = \frac{A}{l} + \frac{f \times h}{2l + (h + y) \frac{\pi}{2}} \quad (42)$$

A = projecting area of polepiece, = top area of polepiece, minus area of magnet-core.

2. Horizontal Horseshoe Type.

The leakage from the polepieces to the yoke partly passes directly across the cores, and partly takes its path through the iron bed; hence, with reference to Fig. 23, we have approximately:

$$P_4 = \frac{A + A_1}{\frac{1}{2}(l + z)} \quad \dots \dots \dots (43)$$



FIGS. 34, 35, 36 AND 37.

A = Half area of external surface of polepiece;
*A*₁ = Projecting area of polepiece, = area of yoke-end of polepiece minus area of magnet-core;
l = Length of magnet core;
z = Distance of pole piece from iron bedplate.

β. Polepieces having no external iron surface opposite them.

1. Inverted Horseshoe Type with rectangular Polepieces.

In this case the leakage from the side surfaces of the

polepieces to the yoke, Fig. 35, is twice that of the upright type:

$$P_4 = \frac{A}{l} + \frac{f \times h}{l + (h + y) \frac{\pi}{4}} \dots \dots \dots (44)$$

2. Inverted Horseshoe Type with Beveled or Rounded Polepieces.

Similar to the former case we have for these forms of the polepieces, Figs. 36 and 37, respectively:

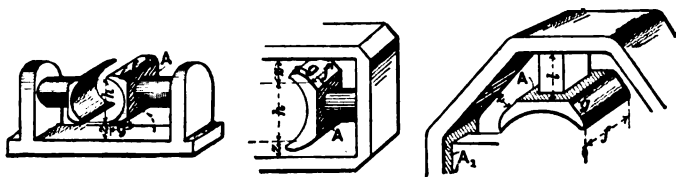
$$P_4 = \frac{A}{l} + \frac{f \times u}{l + (u + y) \frac{\pi}{4}} \dots \dots \dots (45)$$

3. Horizontal Double Magnet Type.

If in this type special polepieces are applied, Fig. 38, lines pass from the lower surfaces of the same to the yoke:

$$P_4 = \frac{f \times g}{z} + \frac{A}{2 \left(z + h \times \frac{\pi}{4} \right)} \dots \dots \dots (46)$$

Here it is supposed that the path from the projecting back-surfaces of the polepieces to the yoke below them is shorter than the length of magnet-cores; if the latter is not the case, the term $\left(z + h \times \frac{\pi}{4} \right)$ in the denominator of the second portion of formula (46) is to be replaced by l , the length of the cores.



FIGS. 38, 39 AND 40.

4. Bipolar Iron Clad Type.

In the bipolar iron clad type with separate poleshoes, Fig. 39, lines leak to the yoke from the back-surfaces of the polepieces; hence the relative permeance:

$$P_4 = \frac{2(g \times f)}{z} + \frac{A}{z + h \times \frac{\pi}{4}} \dots \dots \dots (47)$$

As to the denominator of the second term, see remark to formula (46).

This amount, formula (47), as well as the relative permeance across the side surfaces of the pole pieces, formula (39), is to be added to the relative permeance found by formula (28), iron clad type without polepieces, in order to obtain the total relative permeance of this type.

5. Radial Multipolar Type.

In this type leakage lines pass from the projecting portions, A , Fig. 40, of the backsides of the polepieces to those of the yoke, A_1 ; and if the yoke is relatively near to the pole-gap, leakage also takes place from the end surfaces of the polepieces to the yoke.

$$P_4 = p \times \left(\frac{\frac{1}{2}(A + A_1)}{l} + \frac{2f \times g}{z} \right) \dots \dots \dots (48)$$

According to the design of the frame, then, either formula (48) is to be used together with the latter portion of formula (40), or the entire formula (40) is to be combined with the first portion of formula (48), in order to obtain the total joint permeance across the polepieces and from polepieces to yoke, of the radial multipolar type.

By the proper combination of formulae (13) to (48), the probable leakage factor of any dynamo can be calculated from the dimensions of the machine.

THE INFLUENCE OF ARC LIGHT CARBONS ON THE CANDLE POWER.

BY

H. M. Stacy

THE London *Electrical Review* commenting on the statements made at the Philadelphia meeting of the Institute of Electrical Engineers, concerning the actual candle power of arc lamps, says: "It has long been known that the quantity of light from an arc materially depends upon the quality of the carbon used, though we are not aware that any comparative experiments have ever shown anywhere as great a difference as here mentioned. We have been informed, however, by an arc light station superintendent of wide experience, that it is not unusual to come across carbons that will show a difference of 50 per cent. in the amount of light produced. As this is a matter of much importance to superintendents of arc stations and users of arc lights, we trust that one of our college laboratories will take advantage of the excellent opportunity it offers for investigation and experiment." There is in fact too little reliable data obtainable on this subject, and this is all the more singular since it is a matter of such moment. The same percentage of variation in incandescent lamps would cause much dissatisfaction amongst consumers.

The above quotation has caused me to refer to a report of a careful test, made in the laboratory of Armour Institute during the past year, on the comparative candle power of a number of brands of arc carbons. All the tests in the table were made with the same lamp, under the same conditions, and similar photometric measurements. The carbons were all $\frac{1}{16}$ ". (See table.)

Make of Carbon.	Class.	Average Current. Amperes.	Average E. M. F. of Arc. Volts.	Average Watts.	Average mean hor- izontal C. P.	Variation of C. P. in brand of carbon.	Variations of make.	Variations in watts.	Variations in per- centage of watts.	Variations in per- centage of C. P.
A 1	Solid	9.83	48.6	477	454	99	...	100	0	1
A 2	Solid	9.6	48.9	463.4	443	97	...	97	3	3
A 3	Solid	10.1	45.9	463.4	456	100	...	97	3	0
B	Cored Solid	9.8	46.8	453.7	335	...	78	95	5	27
C	Solid	9.6	47.8	454	372	...	83	95	5	18
D	Solid	9.9	46.1	456.3	372	...	83	95	5	18
E	Solid	9.8	45.4	445	359	...	79	93	7	21
F 1	Cored Solid	9.54	43.5	414.9	293	93	64	87	13	26
F 2	Solid	9.52	49.52	428.6	316	100	70	89	11	30

These tests show that the carbons A (1), A (2), A (3), both upper and lower solid, out of the same lot, were practically uniform, as were also carbons F (1) and F (2) both taken from the same lot. When the different brands were compared, a variation of from 18 per cent. to 36 per cent. with a watt variation of 5 per cent. and 13 per cent. was found. Assuming that the variation in candle power with varying watts is about proportional, the greatest variation between different brands is not far from 30 per cent. Were it not for the fact that the great brightness of the arc renders the eye a poor photometer, such a marked variation as 30 per cent. would be ruinous. As it is, the makers of arc light carbons, we are inclined to believe, pay too little attention to their photometric value under the condition of practical use.

There is probably no one thing connected with electric lighting so unsatisfactory as the carbons with which the market is generally supplied, and the improvement in them

has by no means kept pace with that in the lamps in which they are burned. Perhaps the cause for this lies in the fact that the physics of the voltaic arc is so little understood. If it were clearly proved that the carbon was actually volatilized, or that it was simply carried from the positive carbon to the negative mechanically, and rendered incandescent during its passage, the makers would have a definite aim in their selection of materials and methods of manufacture.

CHIPS FROM A STORAGE BATTERY WORKSHOP.

BY

James H. Russell

1. As "straws show which way the wind blows," so do chips from the workshop show, when taken from the broken and used-up material of a manufactured article, be it engine, boiler or motor, where the weak spots are and why the mechanism gave out before its full estimated work was done. A factory of storage batteries where not only batteries are made but where many of different makes are brought to be charged and repaired, teaches a valuable and practical lesson to the observing mechanic and electrician in charge, and a still sharper lesson to the inventor of storage batteries.

2. Now, not to criticise any particular make of battery, but merely to learn from facts before us, let us take a look at the different makes of batteries, as they are brought into the shop to be charged or repaired. Here are ten from the Phonograph Company. Knowing the hard work, careless handling and rough carriage the batteries for phonograph use have to undergo, we take it for granted by their outward appearance that they have been in use at least six months or a year. These ten are of the Faure type or pasted cells, almost the only ones in use two or three years ago, and still being made. The report sent in with them is, "inefficient," "won't hold up after charging," etc. We open the boxes containing the rubber cell and elements, break away the cement seal and lift out the plates.

We find, first that the thin lead connections on the positive plates are much corroded, and nearly off. In eight of the ten batteries the positive plates are disintegrated and crumbling away in many places. The two others are still in a pretty fair condition, except the lead strip or connection on the positive plate to which the brass terminals have been soldered or burned on; these are nearly corroded off like the others. Here the lesson taught from the chips is obvious. First, connections too thin and weak for durability, under the action of electrolysis. The crumbling of the positive plates shows impurities in the cast lead grid, unequal electro-chemical action between the active material or plugs of peroxide of lead, and the support; hence, weakness and falling apart of the plate.

The negative plates are found as a general thing in good condition, and the only way to repair the cell, if new positive plates are not at hand, or it is not considered worth the expense of putting in new positive plates with old negatives, is to make one set of elements out of two sets of negative plates by converting part of the negative into peroxide plates, which necessitates many hours charging and great care to avoid the generating of too much heat. The expense of doing this is about 40 per cent. of the original cost of making the battery. The example of these ten batteries may not show the proportion of deterioration in pasted plates of this make, that is, eight out of every ten, but is sufficient to show a manufacturer what weak points to avoid.

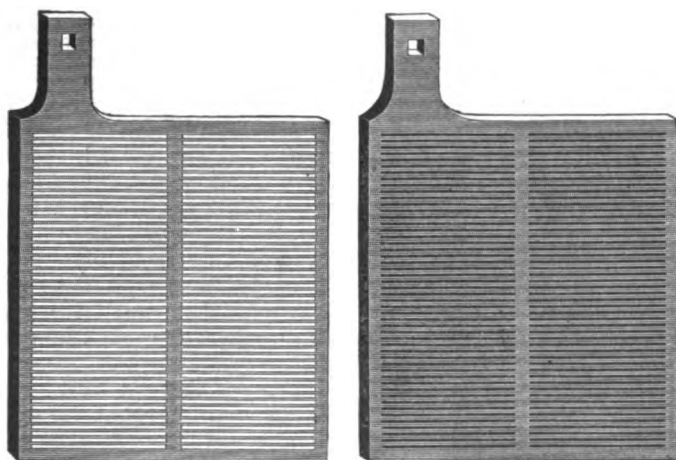
3. Here we have five more batteries brought in on the same day, of the Faure type, but having a thinner plate. The batteries are comparatively light for their estimated, or rather advertised, capacity, and compact; many plates in a cell 6 x 8 inches in size, $\frac{1}{4}$ inch thick. When opened we find everything in a twisted, disintegrated condition. The positive plates nearly all gone; those that remain, buckled and out of shape; even the negative dished or bowed in one direction, and utterly useless except for the junk pile. These batteries, we learn, have been in active use but six months. Notwithstanding the plates of these batteries are guarded and protected from short circuiting by an extensive diaphragm of perforated thin hard rubber, still they show this great weakness. This lesson to the manufacturer is to avoid thin plates and all alloys of lead.

4. Here are some more batteries of the pasted type, but of a different style of grid. The active material is supported in a basket form of cast lead alloy envelope nearly $\frac{1}{2}$ inch in thickness. To see the new plate, one would think the active material could never fall out under any amount of work. In fact we learn that these batteries have been in use longer than the others mentioned, say eight months. Still, what do these before us show? First, on examination, loosened and corroded terminals, although protected by a covering of soft rubber. The positive plates crumbling apart to such an extent that they will not hold together while being lifted out. Here again we learn that cast lead or cast alloys in any shape are subject to gradual disintegration and this basket work casting seems to have suffered by the expansion of the peroxide of lead to a greater extent than the others examined.

5. Here are some more batteries of the pasted type. The grids are made by using a long thin strip of rolled lead, $\frac{1}{8}$ inch wide, convoluted throughout, then bound about on the outer edges by several wrappings of the same strip. This makes a plate about 7 x 6 $\frac{1}{2}$ inches, $\frac{3}{8}$ inch thick, very tenacious and strong and evidently, on account of the flexibility of the rolled lead, able to stand a good deal of expansion while forming the peroxide of lead on the positive electrode. Into these convolutions which make a space of $\frac{1}{4}$ to $\frac{1}{2}$ inch in diameter, the red lead and litharge is pressed. These batteries, now to be examined for repairs, we know have been in use from 18 months to 2 years in phonograph service, and have done good work, better, we learn, than any others up to last year, used by the Phonograph Co. Still on examination the weak points show themselves. The active material is loosened, the binding strips of lead have corroded off on the outer edges, where they are joined together by solder or burning, and the entire binding convolutions unwound, and the plugs of active material, although in good condition, have separated from close contact with the loosened binding walls, and fallen out. There is no way of renewing this style of battery except at the expense of new positive plates. The lesson here is obvious, also, on close examination of a great number of these batteries, otherwise so good, in which this one weakness is the principal fault,—viz., to avoid any connection made by soldering on the plate where the electrolyte falling below the joint may expose it to the air or rather to the action of electrolysis at the point where nascent oxygen or ozone is set free.

6. Here are a few batteries lately brought in, and indeed only introduced in the market during the last year. We examine these batteries with surprise that they should need repair so soon. Much has been said in praise of them. They have been greatly advertised, both in Europe and this country; the plates are protected with all sorts of envelopes to avoid short circuits and disintegration, and still the repair shop, like the medical professor's dissecting table, shows the weak point whose gradual but constant growth brings destruction. The positive plates of this

new battery, brought to our hospital, show faults which need close examination to find, although the report was as before, "won't hold up after charging." We are so doubtful of a weakness in the battery itself that we decide to charge it first just as it came in. A current of 15 amperes for 18 hours is put through it, and then we put it to test ourselves. It shows at start a fairly good voltage; 2.1 at a discharge of 15 amperes, that is, 10 per cent. of its estimated capacity, but very soon the *E. M. F.* drops to 1.5 volts and the amperes run down to 8. We know by this that something is intrinsically wrong in the battery. It is taken out and examined. We find the envelopes of asbestos so decomposed that they have fallen to pieces. This might be expected, as asbestos, being composed of silicates, would surely decompose in the electrolyte, and the round plugs embedded in the plate of cast lead alloy of the positive electrode so loose that the deadly gray sulphate had formed around the plugs, destroying the proper connection between the active material and the conducting support, and thus greatly lessening the efficiency of the battery. Here again we learn the evident impossibility of keeping perfect contact under the process of chemical electrolysis between any form of lead salts, made by a separate chemical process, with metallic lead cast around it, as a conductor and support, however it may be mechanically keyed or locked in the body of the cast lead.



FIGS. 1 AND 2.—PUMPELLY STORAGE BATTERY PLATE.

7. We have still some batteries in our hospital, made by our electro chemical process, in which the active material is part of the decomposed lead of the plate itself. This battery we know was of great promise when it first came out two years ago. It showed high *E. M. F.*, good efficiency, would bear without damage heavy discharge, like most electro-chemically made batteries, and was in every way superior to all the Faure type of plates. But this battery, after six to eight months' use, developed some weaknesses, which our dissecting room showed were in no way owing to the process of forming the plate, for as long as the plate held together, its working was excellent. But the manufacturer had made up the plates of strips of thin lead, $\frac{3}{8}$ of an inch wide, placed in horizontal lines, leaving from $\frac{1}{8}$ to $\frac{1}{4}$ inch space between them, and in order to bind the strips firmly together, they were soldered by an unoxidizable solder to a separate strip of heavier lead on each edge. Here was the weakness. The constant action of electrolysis between the metallic lead, although of the purest quality, and the solder which is always an alloy of two or more metals, set up a local action, within itself, evidently, which gradually destroyed the strength of the lead close to the soldered joint, and thus the positive plate was so weakened that the plates fell apart. Although this is a fault which can be obviated by some mechanical

means it is difficult, and has been accomplished only by means used by a well-known company.

8. The chips gathered together in this storage battery work shop for the last few years have taught their practical lessons, and avoiding all the faults and weak points discovered, the durable as well as efficient battery described below has been evolved. In this battery the lead is selected from the best Galena lead, or what is called virgin lead, free from arsenic or nitrates; it is then rolled out under very heavy hydraulic pressure to $\frac{1}{16}$ ths of an inch in thickness. From this sheet the plates of the proper size are stamped out, the lug to be used as a connection to other plates making up the elements being left as part of the plate itself. The plates are then put through a gang of 60 circular saws devised for the purpose, so that when taken from the machine they show a grid of 60 horizontal strips of lead Fig. 1, with spaces of a little over $\frac{1}{8}$ inch between adjoining strips, but all bound together around the edges and braced through the centre by the lead much thicker than the horizontal strip, which is left untouched by the saws. Thus we have a grid composed of one integral part without soldered or mechanical joints.

When this plate is put through the electro-chemical process, in less than two hours a portion of the lead laminae has been converted throughout the entire plate into lead salts, sufficient to entirely fill the spaces, as shown in Fig. 2. This lead salt, by another process becomes peroxide of lead on a certain number of the plates, which are to be the positive plates, and spongy lead on the remainder, to be used as negative plates. After the completion of this process, the plates are reassembled for market by burning together the lugs left on the plates, but this connection is made at such a height from the surface of the electrolyte, that electrolysis which takes place in charging the battery cannot affect it, even to slightly corrode the lead connection itself. A round lug of lead nearly an inch thick is then cast on the connection, reaching above the cell or containing jar.

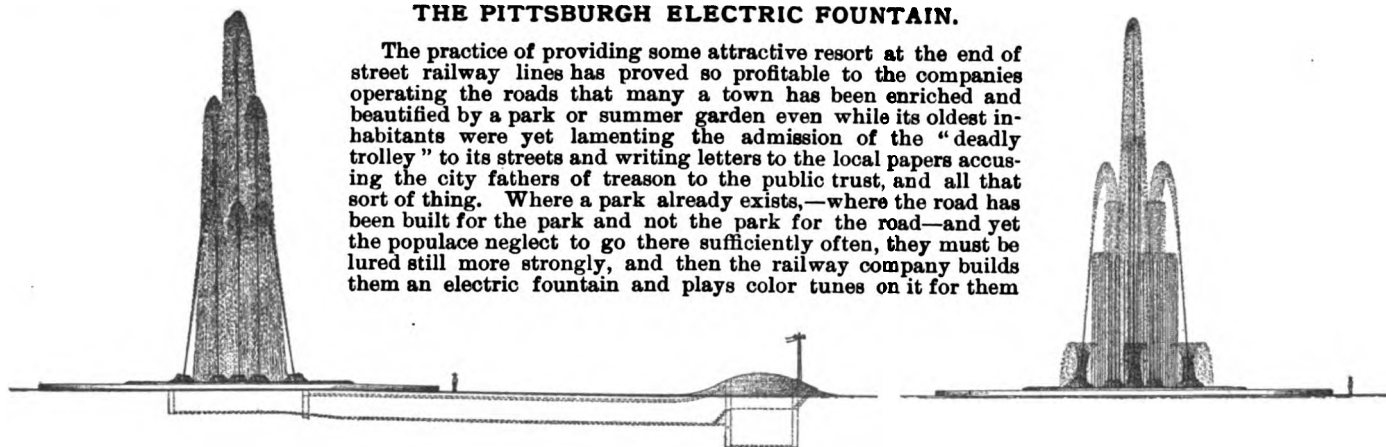
This plate, evolved from experience gained in the storage battery hospital, seems to avoid all the weaknesses above described. Eighteen months of constant use for phonographs, in lighting plants, and in medical cautery work where heavy output of current is called for, has not in a single instance shown a deteriorated plate or one indicating any loss of efficiency.

THE BEHAVIOR OF BISMUTH IN A MAGNETIC FIELD.

The changes of resistance which a spiral of bismuth wire undergoes when placed in a strong magnetic field formed the subject of a paper which was contributed to a recent meeting of the Physical Society of Berlin by Prof. H. du Bois Reymond, Ph.D. It may be remembered that the phenomenon was first noticed by Lord Kelvin, who measured the change in the case of a bismuth spiral situated in a magnetic field of maximum strength, 12,000 c. g. s. units. He also found that the curve of resistance in the field, compared with that of the resistance outside the field, exhibited concavity in its upward trend, and then become straight. The resistance in the field of maximum strength was 1.7 that in zero field. Prof. Reymond has been working at this subject in conjunction with Dr. Henderson, using powerful circular electromagnets, giving an intensity of 38,000 c. g. s. units. He has measured the resistance of bismuth spirals, and observed that the curve of resistance takes a further straight line course, so that the resistance of the field of greatest intensity is three times as great as in a field of zero intensity. By measuring the resistance in a magnetic field at different temperatures, the professor found that in weak fields a rise of temperature increased the resistance; in stronger fields, the effect was less, and became zero in a field of 7,000 c. g. s. units. In still stronger fields the resistance of the warm spiral was less than that of the cold. Prof. du Bois Reymond has hitherto conducted his experiments in temperatures ranging from 0° to 25° C. He proposes to extend them to 100° C.

THE PITTSBURGH ELECTRIC FOUNTAIN.

The practice of providing some attractive resort at the end of street railway lines has proved so profitable to the companies operating the roads that many a town has been enriched and beautified by a park or summer garden even while its oldest inhabitants were yet lamenting the admission of the "deadly trolley" to its streets and writing letters to the local papers accusing the city fathers of treason to the public trust, and all that sort of thing. Where a park already exists,—where the road has been built for the park and not the park for the road—and yet the populace neglect to go there sufficiently often, they must be lured still more strongly, and then the railway company builds them an electric fountain and plays color tunes on it for them



FIGS. 1 AND 2.—PITTSBURGH ELECTRIC FOUNTAIN.

certain nights in the week, or every night, according to circumstances and popular appreciation.

Such a fountain is that at Lincoln Park, Chicago, that draws thousands of people, via the cable railways, each Friday evening during the summer; and such is the one recently put in operation in Pittsburgh, Pa., which, in a number of ways, goes ahead of its predecessors. The Pittsburgh fountain was built jointly by the Duquesne and Pittsburgh Traction Co.'s and the city, at an expense of about \$25,000. It is larger than either of the pair at the Fair and its mechanism has been so simplified that only one man is required to operate it. It is placed in Stanley Park on the traction companies' route and the rocky nature of the soil necessitated so much blasting that the expense of construction was materially increased. The basin is 190 feet in diameter and 15 arc lights of 8,000 c. p. each are required to light the jets. The Washington Electric Co., of Chicago, supplied the lamps which take an alternating current at 50 volts, from a 1,000 volt circuit and are wired in multiple so that they may be independent of one another.

Figs. 1 and 2 show two of the many beautiful combinations the jets may be made to assume, and the former also shows the position of the operating house 100 feet away from the centre of the caisson, where the operator regulates the lights and jets by means of hydraulic cylinders controlled by independent Chapman valves of special design. The mechanism is so arranged that any display can be set before shutting off the preceding one, so that

NOTE ON THE HYSTERESIS OF IRON AND STEEL IN A ROTATING MAGNETIC FIELD.¹

BY F. G. BAILY.

It has long been known that, up to the limits of experiment, the value of hysteresis in an alternating magnetic field increases continuously. But it is a deduction from Prof. Ewing's molecular theory of magnetism that in a rotating magnetic field the hysteresis should diminish at a high induction, or at least show a reduction in the rate of increase. The following experiment substantiates this deduction in a very complete manner:—An electromagnet is rotated on bearings concentric with the bore of its own pole-pieces, which were bored out cylindrically. In the polar cavity a finely-laminated armature is suspended between centres, and held by a spiral spring attached to the axle and to a fixed support. Movement of the armature is indicated by a beam of light reflected from a mirror on it. On rotating the magnet, the armature tends to rotate with it by reason of hysteresis. The motion is checked by the spring, and the consequent deflection is proportional to the instantaneous value of the hysteresis per revolution. The curve of hysteresis and induction obtained commences like that in an alternating field, rising very slowly at first, then more rapidly, but finally reaching a maximum and bending over. The fall is very rapid, so far as the experiments have been tried, shows no sign of becoming asymptotic, but runs straight towards the zero

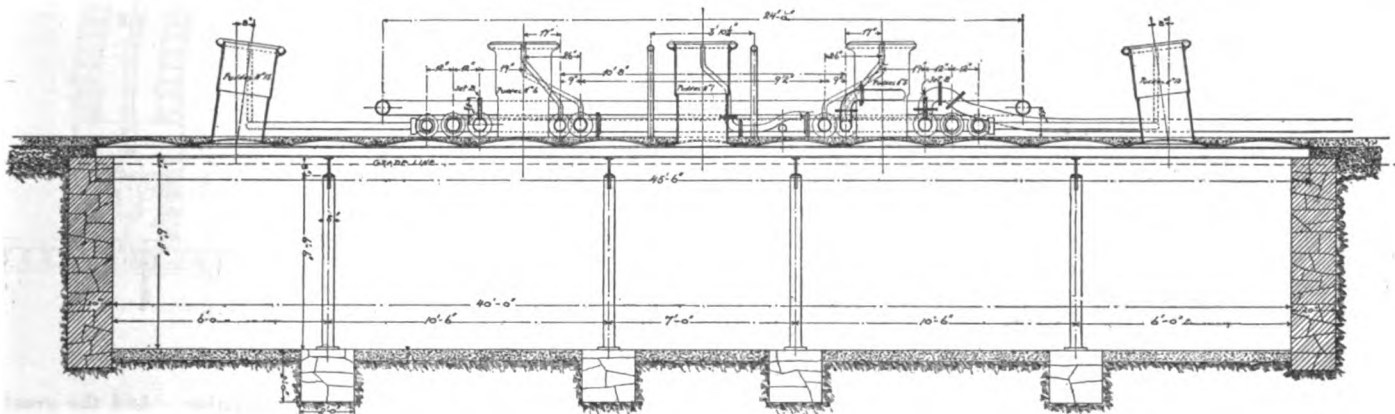


FIG. 3.—TRANSVERSE SECTION OF THE PITTSBURGH ELECTRIC FOUNTAIN.

they may be made to blend into one another like views in a stereopticon and no break need occur between figures. Water is taken from the city mains at a pressure of 135 pounds and 18,000 gallons per minute are used. The central jet rises to a height of 200 feet. Fig. 3 shows a transverse section of the caisson and the position of the jets.

Mr. F. W. Darlington, E. E., of Philadelphia, drew up all the plans and specifications for the fountain and was supervising engineer of the installation which was carried out by Director Bigelow, of the Pittsburgh Department of Public Works.

MR. FRANCIS JEHL, an electrical engineer who has been connected with the old Edison Co. in Europe for the past 14 years, arrived on the steamship Paris of the American Line on Sept. 22. He will shortly locate in this city where he will represent the firm of F. Hardmuth Co., the well known graphite pencil and electric light carbon manufacturers, of Vienna, Austria.

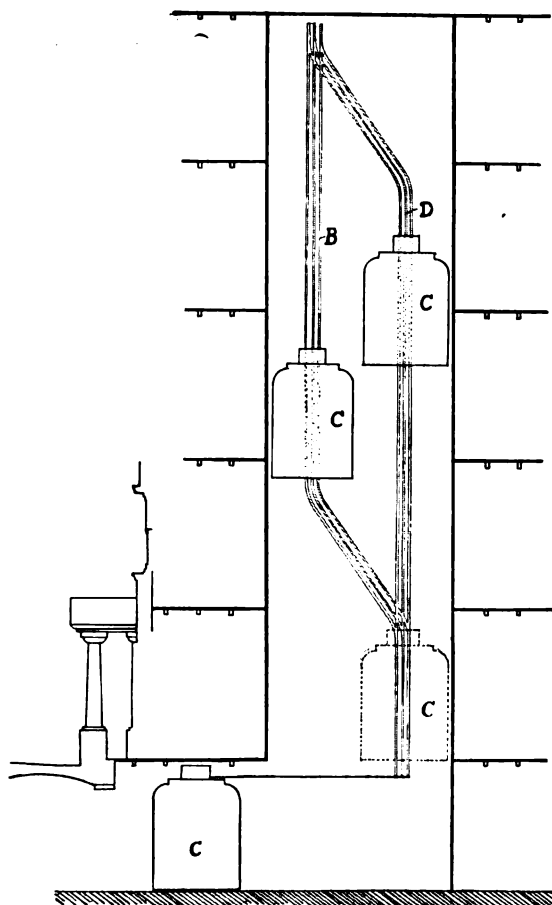
line. Soft iron and hard steel give the same results, the differences between them corresponding to their differences in the B/H curve. The three states of molecular arrangement, which are the essential point of the molecular theory, are exactly reproduced in the hysteresis curve. This first stage of quasi elastic movement gives a very small hysteresis value. The second stage of irregular molecular groups and magnetic combinations gives a value approximately proportional to the induction at a steep inclination; this extends to the knee of the B/H curve. The third stage of approaching saturation gives a rapidly diminishing hysteresis when the molecular magnets are ranged in regular order along lines of force, and new combinations and irregular movements are prevented. Since the non-appearance of a correspondence between the B/H curve and the hysteresis curve in alternating fields has been urged as an argument against the molecular theory

1. Abstract of a paper read before the British Association, Oxford.

of magnetism, this complete accord and verification of the deduction previously made is important as giving powerful support to Prof. Ewing's theory.

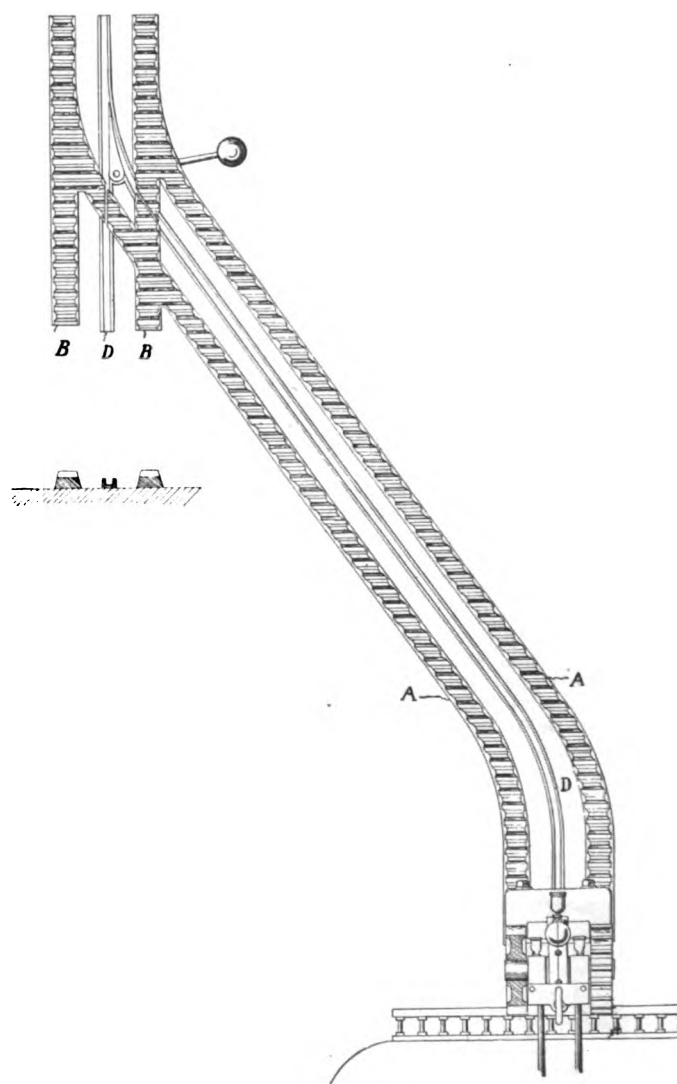
GOVERNMENT CONTROL OF THE TELEPHONE IN ENGLAND.

The British Government has concluded an agreement with the telephone companies of the United Kingdom whereby the control of the system is vested in the hands of the General Postoffice. For the present the State will content itself with the acquisition of the trunk lines, reserving the exclusive right of constructing new lines of this kind, leaving, however, the local exchanges in the hands of their respective companies, subject to State supervision. This is preparatory to the complete absorption of the whole telephonic system, though the licenses of the companies now in existence have still forty years to run. The figure at which the transfer is eventually to be effected is said to be already arranged, at terms identical with those on which the trunk lines have been acquired, namely, the cost price plus 10 per cent. in respect of cost of administration. These conditions are infinitely more favorable than those which the Government accepted when it secured possession of the telegraph.



THE HAMILTON ELECTRIC ELEVATOR SYSTEM.

THE large amount of space required by the present systems, in which a single elevator car, while occupying but a few feet vertically monopolizes a shaft running from top to bottom of the building, becomes a serious question in modern office buildings when size compels the use of a great number of cars to properly accommodate the public. Annoyances perhaps not so serious as the loss of space, but still material, are involved, though indicators be used, in the confusion resulting from the same shaft having at one time an up-going and the next a descending elevator car. It would obviate all of these drawbacks to have all up-going cars in



FIGS. 1 AND 2.—HAMILTON ELECTRIC ELEVATOR SYSTEM.

THE LATE C. H. RUDD.

THE ASSOCIATION OF PRACTICAL ELECTRICIANS, of Chicago, at a recent meeting adopted the following resolutions upon the death of Mr. Charles H. Rudd.

Whereas: In view of the loss we have sustained, by the decease of our Honored Honorary Member, Mr. Chas. H. Rudd, and of the still heavier loss sustained by those who were nearest and dearest; therefore be it

Resolved: That it is but a just tribute to the memory of the departed to say, that in regretting his removal from our midst, we mourn for one who was, in every way, worthy of our greatest respect and regard.

Resolved: That we sincerely condole with the family of the deceased, on the dispensation, with which it has pleased Divine Providence to afflict them, and commend them for consolation, to Him, who orders all things for the best, and whose Chastisements are meant in mercy.

Resolved: That a copy of this heartfelt testimonial of our sympathy and sorrow, be forwarded to the widow of our departed Honorary Member, Mr. Chas. H. Rudd, by the Secretary of the Association—also that this Resolution be placed on the Records of this Association.

Ass'n of Practical Electricians: Committee—J. L. Hagadorn, Duncan Pearce, Geo. H. Farrar.

Those whose privilege it has been to know Mr. Rudd through personal acquaintance will fully appreciate the affectionate regard in which he was held by the Association. He was respected for his ability and attainments and loved for his goodness.

one shaft and all descending cars in another. And the great height of the modern office building allows the adoption of such a method of operation without changing the speed or headway of the cars as they are at present operated.

In the system herein described due to Mr. John Hamilton, of this city, the cars all travel up one shaft and are at the top automatically shifted, without stoppage, to an adjoining shaft, whence they descend to the lower or ground floor, where they are in a similar manner transferred to the up-going shaft. In each car is an indicator which shows the operator the exact position of the neighboring cars. But sole dependence is not placed upon the alertness of the attendant alone. Electric stopping devices are employed to prevent the possibility of accident from collision.

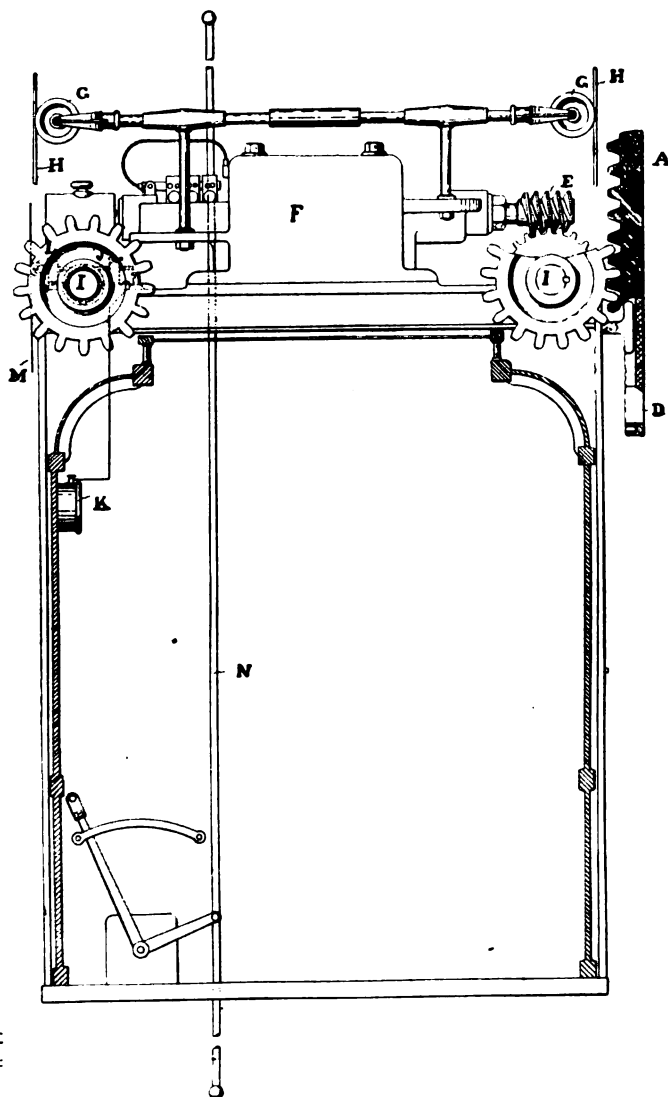
It is claimed that with ordinary speed, headway and number of cars by the use of this system, two elevator shafts will give the same service as five or more, operated according to the old plan, with a large saving in space and horse power required and a great increase of convenience and efficiency in serving the public.

The system, besides, is applicable to freight and mining elevators as well as to passenger elevators and in its application to mines may be made a valuable adjunct to the mine ventilating

devices if the ascending and descending shafts be boxed off so that the elevator platforms will act as air pistons.

In the accompanying illustrations Fig. 1 is a view in elevation of an elevator operating on the Hamilton system. Separate racks, D and B are provided, the former for ascending, the latter for descending cars, C. At top and bottom, the racks and guide tracks, D, Fig. 2, are inclined to direct the cars from one side of the shaft to the other. Fig. 2 also shows the automatically operating switches for effecting their shifting movement. Fig. 3 shows the mechanism at the upper part of the car. Worm gears, E, are operated by an electric motor F, which takes current by trolleys G, from wires H.

The worms on the two sides of the car are pitched in opposite directions, thus doing away with end thrust of the shaft. On the

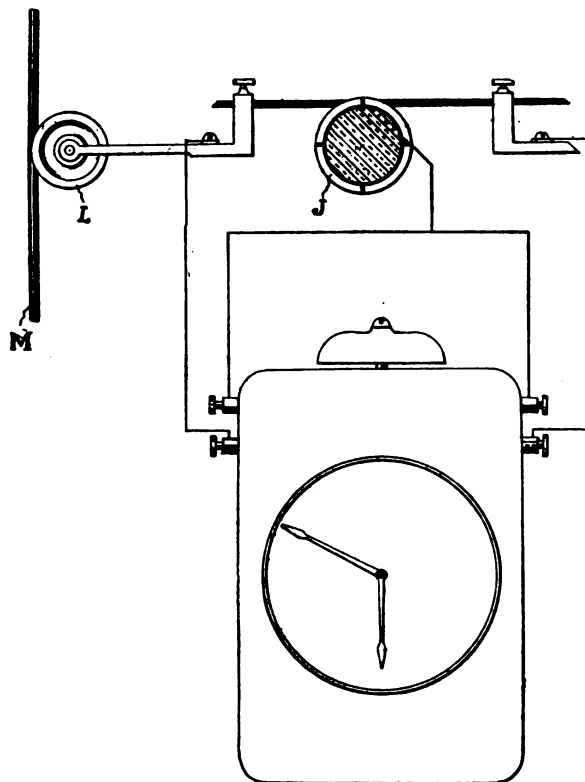


LITERATURE.

The Telephone Hand-Book. By Herbert Laws Webb. Electrician Publishing Company, Chicago. Cloth. 446 pages, 126 cuts. Price, \$1.00.

This manual, written by one who has enjoyed exceptional opportunities for studying the telephone service, is a welcome addition to the rapidly multiplying swarm of electrical books. Its contents justify its being; more than can be said of some technical books now-a-days. Mr. Webb has produced a reasonably complete account of telephonic apparatus and of the telephone service as supplied by the American Bell Telephone Company—which practically amounts to about all the "Exchange" service of the country. He has given, also, a few chapters describing some forms of transmitters and receivers used in Europe. To set forth "Standard American practice" is, however, the professed purpose of the book. This it does in a very satisfactory way, both in respect to the text and, for the most part, the illustrations.

The good old fashioned habit of beginning an electrical book with Thales of Miletus, his amber, and Franklin, his kite, has been happily disregarded by the author; nor does he lumber the volume with tedious compilation from text books of rudimentary electrical principles. The reader is assumed to have been to school at least. This is not to say, however, that the preliminary portion of the book fails to give information adequate to the need of the general reader in respect to the underlying principles of telephony. Apparatus and practice are brought up close to



FIGS. 3 AND 4.—HAMILTON ELECTRIC ELEVATOR.

countershaft, I, is arranged a circuit breaker J, connected to indicator K of its own car, and by trolley L and wire M with the indicator of the car ahead. The divergence of the indicator arrows Fig. 4 shows the distance in feet or time of the car from the car next ahead, so that the elevator men can maintain a substantially even headway between the cars. A rod N, Fig. 3, extending both above and below the car, controls the rheostat lever and so governs the motor, promptly stopping the car if it approaches too near another one.

This rod may also be made to apply a brake to the armature shaft, thus bringing the car to a stand almost instantaneously.

GENL. W. W. DUFFIELD has been appointed superintendent of the Coast and Geodetic Survey, to succeed Prof. Mendenhall. The salary is \$6,000 a year. Genl. Duffield fought in the Mexican and Civil wars, was at one time chief engineer of the Hudson River R. R., and has done much railroad and survey work.

date; the detailed descriptions and drawings of recent forms of long-distance transmitters and of improved multiple switchboards are copious, and, in short, the hand-book—as its name implies—supplies in full measure and in convenient compass such information as all engaged in telephone service would find useful.

It is a pleasure to note the lucid and smooth-running style in which Mr. Webb has written; a pleasure too often wanting in the perusal of technical manuals.

PERSONAL.

MR. W. M. SCHLESINGER.—THE ELECTRICAL ENGINEER will be glad to receive the address of this gentleman from any of its readers.

PROF. W. L. PUFFER, of the Mass. Inst. of Technology is to deliver two courses of lectures, for beginners and advanced students, at the Wells Memorial Institute for Workingmen, Boston.

THE ELECTRICAL ENGINEER.

(INCORPORATED)

PUBLISHED EVERY WEDNESDAY AT
203 Broadway, New York.

Telephone: 1323 Cortlandt. Cable Address: LENGINEER.

Geo. M. Phelps, President. F. R. Colvin, Treas. and Business Manager.

Edited by

T. COMMERFORD MARTIN AND JOSEPH WETZLER.
Associate Editor: GEORGE B. MULDAUR.New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue,
Boston, Mass.Western Editor and Manager, C. KAMMEYER, 1439 Monadnock Building, Chicago,
Ill.New York Representative, 203 Broadway, } W. F. HANKS.
Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada, - - - - -	per annum, \$3.00
Four or more Copies, in Clubs (each) - - - - -	2.50
Great Britain and other Foreign Countries within the Postal Union " - - - - -	5.00
Single Copies, - - - - -	.10

[Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1888.]

EDITORIAL ANNOUNCEMENTS.

Addresses.—Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of THE ELECTRICAL ENGINEER. Communications for the attention of the editors should be addressed, EDITOR OF THE ELECTRICAL ENGINEER, 203 Broadway, New York City.

Communications suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.

Advertisements.—We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers.

VOL. XVIII. NEW YORK, OCTOBER 3, 1894. No. 335.

CONTENTS.

EDITORIALS:—

	PAGE.
The Niagara Power Transmission.....	274
Electric Brakes.....	274
The Carbon Brush.....	275
Arc Light Carbons.....	275
The Work of the Patent Office.....	275
The Telegraphic Press Agencies.....	275

ARTICLES:—

How the Carbon Brush Came into Use.....	ELIHU THOMSON. 265
Electrical Machinist Practice—III. (illustr.).....	J. F. HOBART. 266
Magnetic Leakage in Dynamo-Electric Machinery.—IV. (illustr.).....	A. E. WIENER. 267
The Influence of Arc Light Carbons on the Candle Power. W. F. STINE. 268	
Chips from a Storage Battery Workshop (illustr.).....	J. K. PUMPELLY. 269
The Pittsburgh Electric Fountain (illustr.).....	271
Note on the Hysteresis of Iron and Steel in a Rotating Magnetic Field.....	F. G. BAILEY. 271
The Hamilton Electric Elevator System (illustr.).....	272
The Electric Brake in Practice.—II. (concluded).....	E. A. SPERRY. 276
The Route of the Niagara Power Line (illustr.).....	277
American Electro-Therapeutic Association.....	278
An Evening in Tesla's Laboratory.....	278

NEWS AND NOTES:—

Behavior of Bismuth in a Magnetic Field.....	270
Government Control of the Telephone in England.....	272
The Late C. H. Rudd.....	272
Electrical Muffles.....	277
The Associated Press.....	280

SOCIETY AND CLUB NOTES:—

American Street Railway Association.....	279
N. Y. Electrical Society.....	280

LETTERS TO THE EDITOR:—

Iron Wire for Armatures (illustr.).....	ROBT. LUNDELL. 279
The Insurance View of Insurance.....	A. E. BRADDELL. 279
Iron Wire as Armature Conductors.....	O. P. LOOMIS. 280
Wanted—A Machine for Cutting up Iron.....	W. W. COOLBAUGH. 280

INVENTORS' RECORD:—

Classified Digest of U. S. Electrical Patents Issued September 25, 1894.....	280
--	-----

OBITUARY:—

Mr. J. English.....	280
---------------------	-----

TRADE NOTES AND NOVELTIES AND MECHANICAL DEPARTMENT:—

The New Vertical Ball Engine (illustr.)—The Varley Bug-Proof Bell.....	281
Warren Webster & Co.—The Pittsburgh Insulating Joint (illustr.)—Norwich Insulated Wire Co.—The Accumulator Company's new "I. P." Type Cell (illustr.).....	282
Mather Electric Co.—Chicago City Electric Light Plant.—New York Notes.—New England Notes.....	283
Western Notes.....	284

THE NIAGARA POWER TRANSMISSION.

AS might have been expected, our publication last week of the design and details of the Niagara generators has attracted considerable attention. It will be remembered that a few weeks ago, we published also the transformer plans for the Pittsburgh reduction plant; and this, supplementing the details we have already printed as to the turbines, the subway, the tunnel and the general plan of the enterprise, gives all the information up to date. In our current issue we add the details of the pole line route, which, it will be seen, is very ingeniously arranged to cross over to Grand Island and thence make its way easily to Buffalo. There may develop difficulty in crossing the Niagara River, but on the Island itself the line should be free from trouble. The plan of the pole line is generally like that of the Rome-Tivoli line recently described and illustrated in our pages. It will have steel poles set a depth of six feet in beds of concrete. These should be able to withstand even the fierce rigors of a Lake Erie winter.

It is natural that with the work advancing so steadily and quickly, Buffalo should have its thoughts very much occupied with the subject. The proposition of the *Buffalo Express*, to celebrate the arrival of Niagara power at Buffalo by means of an Electric Carnival and Exposition or display, is received with much enthusiasm locally, and we are glad to see that the City Council has already lent its aid and countenance to the project. The idea is that the current transmitted from Niagara shall be largely, if not wholly, used for the electrical effects and displays in Buffalo, and certainly nothing could give a better demonstration of the fact that the energy of the Falls has become available for distribution. The energy of the Falls and the great Hydraulic tunnel is already availed of in the new paper mills at Port Day, and will soon be in use electrically for the Pittsburgh Reduction Works and the Acheson Carborundum factory, near the great power house. Its simultaneous utilization electrically 20 miles away in Buffalo will be an event long to be remembered and will be as momentous in New York State history as Fulton's trip with his steamboat and the opening of the Erie Canal by Governor Clinton. Indeed, it will mean more than either of those great events.

ELECTRIC BRAKES.

THE description of the Sperry electric brake which we gave in a recent issue is now supplemented by the excellent paper read by Mr. Sperry before the American Institute of Electrical Engineers, in which he gives some details of the considerations which led him to the adoption of the form now employed by him. The abandonment of the trolley current itself as the magnetizing force for the brake was a bold step and the employment of the motor as a generator for that purpose would at first sight hardly appear to have simplified the problem. But besides the economy of this method the other advantages which accrue from it point to the wisdom of the choice. Among the noteworthy effects observed by Mr. Sperry is that by far the greater portion of the retarding effect of the brake is due to the action of Foucault currents, and not to the direct friction between the brake discs. The actual

application of a *lubricating* material between the brake discs in the shape of graphite, to facilitate the generation of the Foucault currents is an anomaly which the most vivid imagination could hardly have foreshadowed. Another remarkable manifestation which is well worthy of further study is the time prolongation of the falling magnetism in the brake discs. Though the slow dying out of the magnetism in closed magnetic circuits is a well-known phenomenon one is not prepared to expect such powerful manifestations of this effect as described by Mr. Sperry. Taken altogether this latest form of electric brake appears to put in the hands of the motorman a powerful means for the prevention of the accidents largely due to lack of controlling power, or to the time required to bring such power into operation.

THE CARBON BRUSH.

The carbon brush, to-day in universal use, now attracts little or no attention. It is looked upon as the natural accompaniment of every railway motor and generator and is used in much other power apparatus. Yet as small a detail as it appears to be, its importance is well demonstrated by the most interesting account, given by Prof. Elihu Thomson in this issue, of the events which led to its adoption. To the late C. J. Van Depoele, Prof. Thomson gives the credit of having first suggested the use of carbon brushes for railway work, and, considering the almost perilous condition in which street railway work found itself commercially, with the old copper brush, the idea was little short of an inspiration. This adds another to the tributes that must be accorded to the genius of Mr. Van Depoele, to whom the electrical art in America is indebted in many ways. It is too early to write the history of electricity in America, but when, a generation or two hence, a calm survey of the field is undertaken, we believe that Mr. Van Depoele will be given a high place among those who have made the art what it is.

ARC LIGHT CARBONS.

We print on another page a most interesting contribution by Prof. W. M. Stine, of the Armour Institute, of Chicago, embodying the results of a prolonged test of various makes of arc light carbons. He throws much light on a most important question. Given a good arc lamp to begin with—and it will be conceded that such a lamp is now available—the question of the character of the carbon is an all important one. The variation in candle-power due to difference in quality of the carbon has been well known but, as pointed out by Prof. Stine, the intrinsic brightness of the arc makes the eye a poor instrument of measurement. While it is not an uncommon practice for station managers to test carbons for watts consumed, there are probably few arc stations equipped with a photometer; but according to the results shown, such an instrument ought to be at hand for the benefit both of the station and of the consumer. The standard adopted by the National Electric Light Association, making the nominal 2,000 c. p. arc lamp one requiring on the average 450 volts for its maintenance, would therefore seem to require some modification or clause which would take into account the quality of the carbon. The facts brought out by Professor Stine call attention once more to the point that much improvement is still possible in arc carbon manufacture. Aside from the nature of the materials used, it would seem that their treatment, and more especially the process of baking, as now carried on, is one which is scarcely calculated to give uniformity of product. Various methods for obtaining the desired end have been recently suggested and, it is hoped, will be given a trial.

THE WORK OF THE PATENT OFFICE.

The general impression has been that the prolonged and unparalleled dulness in trade has affected the work of the U. S. Patent Office and from the advance figures of Commissioner Seymour it now appears that this opinion is well founded. While in the fiscal year 1894 only 39,206 applications were made, there were 43,589 in 1893, 43,544 in 1892, 43,616 in 1891, and 43,810 in 1890. The falling off in applications has resulted in a decreased income from fees, the net receipts having been \$1,183,523.18 and the net expenditures \$1,053,962.38. Now that business is improving, we note all around us greater activity in invention, and hope that in the electrical field at least, the number of new applications for patents will be larger than it has ever been before. The situation illustrates the extent to which invention is dependent upon capital. It is a matter of common experience that the instances are extremely rare in which an inventor does not receive outside pecuniary support while developing his notions and apparatus, and during the last year or two so few people have had anything to spare, the inventor has had to be content with simply nursing his hopes. The pause may perhaps give us better inventions than if there had been no such intermission. The first impulse of an inventor is to borrow some money and try his new theories. A great inventor said to us one day that if he tried every new principle or combination that popped into his head, he could "bust two banks every day." But given the conditions of penury and long meditation, the worse and wilder ideas are likely to be abandoned, the sifting process leaving available something of real advantage to mankind.

We are sorry to note that in spite of the smaller amount of work done by the Patent Office, the end of the year saw no fewer than 7076 applications on hand awaiting attention. Only eight out of the thirty-four divisions were within one month of date, on their work, and sixteen divisions were two months behind. The office should be better manned, and its staff be better paid.

THE TELEGRAPHIC NEWS AGENCIES.

For some time past the United Press and the Associated Press have been disgusting the public by elaborately blackguarding each other and rushing into print every time some little back country sheet has, by lure or coercion, changed its source of news supply. We beg to assure both parties that the public takes no interest in this squabble and will certainly not help one or the other to constitute itself into a telegraphic news monopoly. It is better that both exist, and they should try to do so in peace and decency, not forgetting meantime to improve their service as much as possible. To our way of thinking, neither Press is yet as well equipped as it might be with the resources necessary to the collection and transmission of news, and this view of the case is borne out by the kind remarks that are made on each side as to the other's ability. "A plague on both your houses!" is a natural ejaculation in these days, when one takes up a paper to find out what the world is doing and thinking and is at once plunged into columns of riotous invective showing that a Chinese victory was reported ten minutes before it had happened, or that a Jack the Ripper murder in London was really a case of suicide. All these things are very tiring, and we urge our telegraphic news friends to "give us a rest."

THE ELECTRIC BRAKE IN PRACTICE.¹—II.

(Concluded.)

BY ELMER A. SPERRY.

As to the effect of the electric brake on the total temperature of the motor, the difference in the average atmospheric temperatures during two days was six and one-half degrees, and the difference in the average temperature of the motor parts was seven degrees, making only a difference of one-half of one degree Centigrade as the total increase of temperature from the use of the brake. Observations in reference to the heat in the rheostat were made, although no temperatures were taken, and no difference could be observed in reference to the heating of this portion of the equipment. The explanation will be found in the comparatively small amount of current, and the relative infrequency of its application, and short duration at the time of each application. The following wattmeter readings have also been taken:

	1st Trip.	2nd Trip Trailer.
Reading of wattmeter, leaving Lake View....	893,533.9	392,542.25
Reading of wattmeter, end of round trip....	893,543.25	392,547.1
Number of full stops.....	55	53
Number of slow-ups.....	42	37
Time.....	1:40	1:35
Difference in reading.....	8.35	4.85
Constant of wattmeter equals ".22"; total watts, both trips, 180.4.		

Another interesting feature in this connection is that a flat wheel from skidding is an impossibility. It will readily be seen that should the wheels stop, the generator connected with the axles ceases to produce current, and none therefore exists to farther apply the brake, and though they may be sliding forward on the rail, yet the wheels continue to rotate more or less, and constantly present new surfaces for the sliding contact.

The braking action is two-fold and is especially efficient. The rotating armature of the motor, instead of tugging ahead by its momentum, is itself pulling back and more or less powerfully braking the car through the gears by the retarding effort of the magnetism of its field while generating the braking current. The power required therefore to perform this work is taken from the energy of the moving car which it is desired to destroy; not only is the car thus retarded, but the electric brakes arrest the motion of the wheels direct, with a force that is remarkably powerful and under perfect control of the motorman.

Two forms of braking magnets are used, one for winding up a brake chain usually employed in connection with the trailer, and another for directly arresting the motion of the axles, one magnet only being used in connection with each axle. These magnets are truck-mounted, not an ounce of their weight being directly on the axle, and are so supported that their gravity acts to automatically retract them from the brake face. The brake face is automatically lubricated to a slight degree, receives a high polish and does not cut or rapidly wear. The brake is noiseless in its operation. Inasmuch as it does not revolve, no commutating or contact device is necessary. Its crescent form accomplishes important technical functions and also eliminates the necessity of pulling off a wheel for its attachment, removal or inspection. Its face is *solid unbroken metal* with no grooves or interstices for catching grit or sand, which in part explains the absence of wear above referred to. The brake magnet is practically indestructible, a few turns of stout wire constituting its one coil entirely enclosed and sealed in metal. No harm nor moisture can reach it. As to moisture, it is immaterial, as the E. M. F. at which it works is extremely small, seldom reaching six volts. The lubricator for the brake surface is dry, not sticky or adhesive, and does not gather sand or dirt and retain it upon the braking face. No mechanical pressures whatever are employed to arrest the car, and hence no strain or shoulder-wear comes upon the journals.

In constructing the brake magnets their proportions and the arrangement of the magnetic circuits received considerable study. It was during some preliminary experiments that an unexpected phenomenon was noticed; namely, that the retarding effect when speed is an element, is very much more than would have been expected from the co-efficient of friction due to magnetic attraction or adhesion, this latter being a known and definite quantity. Further experiment made to ascertain the cause, showed it to be due to Foucault or eddy currents set up in the masses. The conditions and structure of the brake magnet were therefore varied in a number of particulars, especially such as would be expected to give the greatest result in Foucault currents produced. The result was immediately successful. It was found that the retarding effect of the brake magnet is due very much more to the generation of these currents than to the direct effect of the coefficient of friction resulting from direct magnetic adhesion, the amount of which I find can be relied on accurately when employed by itself. Some of the forms of brake magnets experimented with were provided with numerous poles of opposite polarity, which were worked upon three different kinds of armature, two of which had radial teeth of different number relative to those in the magnet, and one being a plain disc armature. The toothed armature, while it causes a series of sudden jerks and is also unsatisfactory in the total retardation resulting from a given input, is found also upon rupture of the magnetic circuit to impart

to the magnet coil certain counter E. M. F.'s which materially cut down the current supply and thus the capacity of the device. A magnet formed of a continuous disc with an annular groove sunk in its face, is found to give very satisfactory results, but is much heavier and requires an armature twice as heavy for a given number of lines as the double circuit magnet used. Furthermore, the relative rotation between such a magnet and its armature affords no point in the masses where the lines are interrupted or changed and the Foucault currents, or reactionary effects set up, are very much inferior to those in a magnet where a gap or cessation of magnetic stress is easily produced. As a result of these investigations the crescent form has been adopted, the opening in the crescent giving the effect referred to, as well as affording an excellent method of attachment and removal of the brake magnet, and at the same time supplying a gap for easily reaching the face for inspection and lubrication. The belief that the extra retarding phenomenon is that of Foucault or other eddy currents is borne out by the fact that a conducting lubricant such as graphite is found to considerably increase the effect; also metal filling between the polar faces is almost indispensable for the best result, while at the same time effectually protecting the coil from all damage. These observations would seem to indicate that the eddy currents, however produced, circulate in both masses near the surface, and traverse back and forth across the air-gap whenever ample provision is made to allow them so to do. The practical value of the combined action of all these forces in increasing the retarding effect, results in necessitating but a small magnet, and a smaller current expenditure considering the work performed.

By reference to Table I., the result in retardation gained through the eddy or other currents may be plainly seen, column A indicating the retarding effect which should be expected from a friction coefficient of 10 per cent. between the lubricated surfaces due to magnetic attraction of the lines actually circulating; and column B indicating the values of retardation actually obtained on the dynamometer.

TABLE I.

Amperes.	Volts.	"A" Full due to magnetic adhesion or traction. Friction coefficient 10 per cent.	"B" Pull on brake chain obtained. Graphite lubrication.
5	1	7.6 lbs.	125 lbs.
9	1.8	18.8	300
9.5	1.9	36.4	608
15	3.	121.	1976
16	3.2	149.	2432
20	4.	158.4	2584
23	4.6	167.	2736
25	5.	186.	3040
31	6.2	207.	3385
35	7.	213.	3490
35.5	7.8	214.	3500
41	8.5	223.	3650

The assumed values are based on a traction of 98.25 lbs. per square inch for 45,000 lines per square inch, being the assumed values at the knee of the curve easily recognized as occurring between 16 and 20 amperes in the table.

It will thus be seen that the brake is automatic and does its work without any special act or even the knowledge of the motorman. He simply "works a single handle" back and forth and electricity "does the rest." Suppose the motorman wishes to stop his car, he turns off the current by simply swinging the lever over to the right. This operation is made to automatically convert the motor into a special dynamo for generating currents at very low speeds, and also simultaneously to cut off all connection with the trolley current. The brakes are then applied by simply swinging the handle back over the path it has just traversed; the farther it is swung to the left, the stronger the brakes are applied. The act of releasing or letting off the brakes, again automatically re-establishes connection with the trolley and re-converts the dynamo into a motor. The same rheostat and contacts are applied to control the motor while running the car, and also to control the slight amount of current generated by the transformed dynamo which is sufficient to brake the train.

The motorman cannot turn on the current before the brakes have been released, nor can he apply the brakes before the current has been turned off. This is a result of construction, and constitutes a feature of merit in the new electric brake, effecting an economy in current and a saving in wear and tear.

Operating the brake in this manner, it will at once be seen that the system is one of the utmost certainty of operation, surer even than the hand brake, air or other power brake, from the fact that every time the car runs, the motor, which is depended on for the braking action, receives a test, and its fitness and capacity for the next brake application is constantly being demonstrated. On the other hand, the motorman never knows whether his hand brake is sure to operate when called upon for the next application.

The advantages found to result from the practical use of the electric brake as compared with former brake systems; its qualities as an accident preventer, as well as its general commercial value, may be recapitulated as follows: 1. The certainty of its operation. 2. The enormous power at instant command and under perfect control. 3. The absence of all power absorption at moneyed cost from the central station. 4. Its high efficiency, being far superior to compressed air; amply proven in numberless instances where electricity has replaced air. (The air requires a direct application of energy, amounting to an immense aggregate power-absorption during the day from the central station; the working parts of the air machinery are attached to the car axles and require a large quantity of energy, not only while compressing, but at other times as well.) 5. Its extreme simplicity. 6. Observed saving in wheels, two to three-fold. 7. Entire saving in brake shoes. 8. Lubrication of brake face; very little wear of either wheel or magnet. 9. Absolute silence of operation and release. (No hissing to frighten horses on streets.) 10. The low E. M. F. at which it operates. 11. The ease of its application and control. 12. Conserving strength, and prolonging the usefulness and life of the motormen. 13. The smoothness of its operation. 14. Cannot cause flat wheels.

THE ROUTE OF THE NIAGARA POWER LINE.

Last week we published the first drawing given out, of the new 5,000 H. P. generator built for the Niagara Falls power transmission by the Westinghouse Co. Through the courtesy of the



MAP SHOWING THE ROUTE OF THE NIAGARA POWER LINE TO BUFFALO.

Buffalo Express we are now able to show the route of the pole line which is to carry the circuits from the Falls to the city. The tunnel subway that was illustrated in our columns,¹ is intended for local distribution chiefly on the Niagara Cataract Construction Co.'s property. The greater portion of the circuits will, however, be aerial and will be built on the plan of the Tivoli-Rome line.² As to the route, it has been assumed by many that the pole line would follow the railway tracks along the main shore of the lake,

through Tonawanda or cut directly across the farms on the Lake bank. It will be seen, however, that use is made of Grand Island in a very ingenious and effective manner. The Buffalo Express gives the following information on the subject:—

When Niagara's power comes to Buffalo, how will it come? The question has been asked so many times that *The Express* answers it by printing the little map which accompanies this article. It shows at a glance the route which has already been secured for the power lines to the city through Grand Island. Mr. John J. MacIntire of Niagara Falls acquired the right of way for this line and all the contracts are now a matter of record. It will be noticed that there are two lines to the island. One, it will be seen on examination, comes from Canada and the other from this side. The first heavy dotted line shows the line of transmission as it leaves the power-house on this side of the river. It crosses shoal water in the river for some distance and is carried over the navigable channel at the foot of Buckhorn Island on poles. In fact, the line is to be run on poles all the way. Wherever it crosses a navigable stream it will be carried high enough in the air not to interfere with boats. That at least is the present plan, though before the line is constructed some new insulation may be discovered that will allow the wires to be laid under water. In fact, experiments are now being made with an insulation for that purpose.

The line of transmission skirts the shore of Buckhorn Island, crosses to Grand Island and runs through it on a straight line. In acquiring the right of way Mr. MacIntire took the side lines of the farms and obtained from the owners on each side 15 feet, thus giving the company a right of way 80 feet wide. Of course, if any more land is wanted for transformers or other purposes it can readily be obtained. Where the line turns towards Buffalo it will be seen that it is no longer straight, but has queer little jogs and turns. Local conditions made this necessary. Two lines spring from Grand Island to Strawberry Island on the way to Buffalo. That is simply so that if something should happen to one line there would be another to fall back upon. The transmitting line reaches Buffalo just inside the city limits, where the power will be taken by the Buffalo company formed for its distribution in this city.

A glance again at the map will show how the line from the power which is to be developed from the Canadian tunnel will join the main line on Grand Island. It will also be noted that there is a second line running part way down the island. That is simply a sort of reserve line, though it is also projected to meet the contemplated development of Grand Island, for which there are in existence some very elaborate plans. It will also be seen that a line crosses to Grand Island from the main shore near LaSalle. This is to connect with a line, the right of way for which is now being obtained down the main shore. It seems probable, however, that the line through Grand Island will be used as the main line and that along the main shore as a reserve or auxiliary line. The line through the island is $18\frac{1}{2}$ miles long and that by the shore will be $18\frac{1}{4}$ miles.

All in all, it will be seen that the Cataract Construction Company is making very elaborate plans to supply Buffalo with power and to insure a steady supply. Every precaution is being taken to that end.

ELECTRICAL MUFFLES.

FROM a casual observation which occurs in a recent paper communicated to the Paris Academy of Science by G. Charpy, and dealing with the allotropic changes of iron under the influence of heat, we gather, says the London *Electrical Review*, that an electric muffle is now a fairly common adjunct to the metallurgist's laboratory—at least in France. The advantages of electrical resistance in bringing metals to high temperatures which are evenly distributed, and can be elevated gradually, are now recognized in many industries, and are destined to be much more widely exploited. An electric muffle at once suggests the adaptation of the principle of resistance to the "firing" of pottery. When valuable porcelain is "fired" in a kiln heated by means of fuel, many expensive precautions have to be taken so as to prevent the delicate glazes and colors from being impaired by the products of combustion. Small gas kilns and muffles have found a ready sale because the products of combustion of gas are not quite so injurious to porcelain as are those of fuel. Now, since a muffle can be heated to any degree of temperature possible by other methods by means of electrical resistance, and since no

1. See *ELEC. ENGINEER*, Jan. 17, 1894, p. 46.

2. See *ELEC. ENGINEER*, May 16, 1894, p. 425.

fumes or injurious products whatever accompany this use of electricity, it seems to be obvious that electric muffles, and even kilns, would be a success.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.

The fourth annual meeting of the American Electro-Therapeutic Association was held at the New York Academy of Medicine, New York City, September 25, 26 and 27. The proceedings opened at 10 o'clock on Tuesday morning with an executive session at which a number of new members were elected and upon the recommendation of the executive council, Prof. D'Arsonval of Paris; Prof. Elihu Thomson, Lynn, Mass.; Prof. John W. Longley, Cleveland, O.; and Dr. J. Bergonie, Bordeaux, France, were made honorary fellows.

At the regular morning meeting the president, Dr. W. J. HERDMAN, of Ann Arbor, Mich., read an address upon "The Function of the American Electro-Therapeutic Association." Following this address the committees on scientific questions rendered their reports as follows: On Standard Coils, Dr. W. J. MORTON, New York. On Standard Meters, Dr. MARGARET A. CLEAVES, New York. On Standard Electro-Static or Influence Machines, Dr. W. J. MORTON, New York. On Constant Current Generators and Controllers, Dr. W. J. HERDMAN, Ann Arbor, Mich. On Standard Electrodes, Dr. A. LAPHORN SMITH, Montreal. Exhibit of stand and electrode for Static Electricity, Dr. LUCY HALL-BROWN, Brooklyn, N. Y. On Electric Light as a Therapeutic and Diagnostic Agent, Dr. MARGARET A. CLEAVES, New York. Exhibit of a rheostat for controlling the static induced current, Dr. MARGARET A. CLEAVES, New York. Exhibit of a portable battery for electric illumination, Dr. ROBERT NEWMAN, New York. On the Sinusoidal Method of Regulation—the E. M. F. and Resultant Current, Dr. LUCY HALL-BROWN, Brooklyn, N. Y.

During the afternoon session the constant current was discussed under the following heads: Physics, Current Distribution, Mr. W. J. JENES, M.A.I.E.E., New York; Physiological Effects, Professor A. E. DOLBEAR, Tufts College, Boston, Mass.; Therapeutic Uses—General, Dr. A. D. ROCKWELL, New York; Gynaecological, The Galvanic Current in Catarrhal Affections of the Uterus, Dr. G. BETTON MASSEY, Philadelphia; Ultimate Results of Conservative Electrical Treatment in Gynaecology—Consecutive Pregnancies—Dr. GEORGES APOSTOLLI, Paris; Treatment of Urethral Stricture, Report to date, Dr. ROBERT NEWMAN, New York; Behavior of Cancer Under Mild Galvanic Currents, Dr. R. J. NUNN, Savannah, Ga.

In the evening a reception to the Association was given at the Academy of Medicine by the resident Fellows. An interesting exhibit of electro-medical apparatus was a feature of the evening; an excellent collation was served and toasts were drunk to the continued success of the association and the health of its officers and members.

On Wednesday morning the discussion of the constant current was continued and the following papers were read: The Action of Electricity on the Sympathetic, Dr. A. D. ROCKWELL, New York. Metallic Electrolysis, M. le Docteur GEORGES GAUTIER, Paris; Dr. WM. JAS. MORTON, New York; Dr. MARGARET A. CLEAVES, New York; Dr. A. H. GOELET, New York. Diseases of the Eye, Electro-Therapeutics of, Dr. L. A. W. ALLEMAN, Brooklyn, N. Y. Notes on Goitre and Improvements in Apparatus for Treatment of same, Dr. CHAS. H. DICKENS, Toronto. Diseases of the Nervous System, the Treatment of Neuritis by the Galvanic and Faradic Currents, Dr. LONDON CARTER GRAY, New York. Physics of the Electric Light in Relation to Organized Matter, PROF. JOHN O. REED, Ph. M., Asst. Prof. of Physics, University of Michigan. Hydro-Electric Methods, Physics and Appliances, MR. NEWMAN LAWRENCE, M. I. E. E., London. Special Hydro-Electric Applications, Dr. MARGARET A. CLEAVES, New York. The Hydro-Electric Therapeutics of the Constant Current, Dr. W. S. HEDLEY, Brighton, England. Effects of High Frequency Discharges, PROF. ELIHU THOMSON, in which he condensed the results of those of his experiments which have had especial reference to the passage of high frequency current through the human body, and which have tended to show the true nature of the phenomena in their physical aspect. Some Landmarks of Electro-Therapeutics, Dr. O. S. PHELPS, New York.

On Wednesday evening an executive session was held and the following officers were elected: President—Dr. A. Laphorn Smith; First Vice President—Dr. J. H. Kellogg, Michigan; Second Vice President—Dr. Charles R. Dickson, Toronto; Secretary—Dr. Emil Heuel, New-York City; Treasurer—Dr. R. J. Nunn, Savannah; Executive Council—Drs. W. J. Herdman, Ann Arbor, Mich.; Augustin H. Goelet and W. J. Morton of New-York; G. Betton Massey, Philadelphia, and O. B. Douglass, New-York.

Tuesday was devoted to the reading of papers as follows:

Induction Currents.—Physiological Effects, Dr. W. J. ENGELMANN, St. Louis, Mo. Therapeutic Uses, General Faradization, Dr. A. D. ROCKWELL, New York. Gynaecological, Dr. A. H. GOELET, New York; Dr. H. E. HAYD, New York; Dr. A. LAPHORN SMITH, Montreal.

Sinusoidal Current.—Physics, MR. A. E. KENNELLY, F. R. A. S., Philadelphia. Physiological Effects, Dr. W. J. HERDMAN, Ann Arbor, Mich.; Dr. J. H. KELLOGG, Battle Creek, Mich. Therapeutic Uses, Dr. MARGARET A. CLEAVES, New York; Dr. WM. JAS. MORTON, New York; Dr. J. H. KELLOGG, Battle Creek, Mich.; Dr. HOLFORD WALKER, Toronto; Dr. A. H. GOELET, New York. Les Courants Alternatifs, leur transformation, leur mesure et leurs applications therapeutiques, MM. les Docteurs GAUTIER ET LARAT, Paris.

Static and Static Induced Current.—Physics, PROF. EDWIN J. HOUSTON, Ph. D., Philadelphia. Physiological Effects, Dr. WM. JAS. MORTON, New York. General Therapeutic Uses, Dr. WM. JAS. MORTON, New York. The Treatment of Chorea, Dr. D. R. BROWER, Chicago. Static Induced, Dr. MARGARET A. CLEAVES, New York. High Frequency Currents derived from Static Machines as per d'Arsonval Method, Dr. J. H. KELLOGG, Battle Creek, Mich.

PROF. HOUSTON and MR. KENNELLY also presented a paper dealing with the question of death by electrocution. They referred to the experiments of d'Arsonval and to their own in which dogs had been killed by the current. From these investigations they arrived at the conclusions: 1. That the passage of a sufficiently powerful current through the body of an animal is followed by instantaneous, painless and absolute death. 2. That, therefore, where electrocution is properly carried out there is not even a remote possibility of subsequent resuscitation of the criminal. 3. That in cases of accidental contact, where the current is not excessive, it is quite possible that death may be apparent only, and that the method of artificial respiration suggested by d'Arsonval should invariably be followed.

This was practically the last session of the meeting. In the evening Mr. Tesla entertained the Association at his private laboratory, and on Friday morning Mr. Edison's laboratory at Llewellyn Park was visited.

AN EVENING IN TESLA'S LABORATORY.

WHILE the American Electro-Therapeutic Association was accorded a great honor in being the first body to receive an invitation to visit the Tesla Laboratory, and showed its appreciation by a large muster, it must be said that to engineers present the demonstrations made were even more interesting than to the physicians. The feature of the reception on Thursday evening was the exhibition of a recent form of Mr. Tesla's new machine, the oscillator, which was running beautifully and with which the experiments were performed. Some of these experiments were certainly quite remarkable. The oscillator was run at 350 pounds steam pressure, and in the course of his conversational remarks Mr. Tesla said that he did not anticipate any difficulty in running at much higher pressure with such a machine. There were two pistons in the machine vibrating in opposite phase 80 times a second. The vibrations of these pistons developed an electric current which was led to a bank of lamps, and some 50 incandescents were lit up by the current. Arc lights were also shown in operation, and Mr. Tesla pointed out the curious fact that when arcs were operated from this new type of machine, the oscillations of the pistons were but a fraction of the time of the oscillation of the carbon rod; and hence the lamps instead of pumping or jumping as they so often do when fed from the ordinary rotating machines, were as absolutely steady as though they were on a battery circuit. The ordinary rotating dynamo has inertia which requires time to respond, and hence considerable resistance, ohmic or inductive, must be provided in the ordinary arc armature; otherwise the amount of arc lights or variable load on the machine must be comparatively small in proportion to the steady load of incandescent lights.

Mr. Tesla repeated also what he said, as to another feature of advantage in the oscillator, at the time he first brought it to notice before the Chicago Electrical Congress, namely, the production of currents of constant period and the perfect maintenance of the regime once established. This enables him to perform experiments remarkable for the small amount of energy they take as compared with ordinary alternators. Mr. Tesla expressed the belief that by further perfecting such machines he will have at hand the means for transmitting intelligence to a distance without wires, as already pointed out in one of his recent lectures. He asserted that this problem depended solely on the perfection of this machine.

One of the very interesting and striking experiments shown was the following: Mr. Tesla had a circle or cylinder frame about 4 feet in diameter in a room about 40 feet by 80. This circle was composed of a number of turns of copper wire, and was entirely unconnected with anything and remote from anything, being in the centre of the open space. It was adjusted to the vibration of a current which passed through a wire stretched around the room; and vacuum tubes and small incandescent lamps were lighted by proper adjustments of the capacity of the circuit.

Another curious and suggestive experiment was the following. A small hoop or circle, about 8 feet in diameter was shown wound

with fine wire. Mr. Tesla explained that he had adjusted the wire to the ordinary average "capacity" of plain citizens, in such a way that the maximum current would flow through the wire. The ends of the wire were connected to two handles which could be grasped so as to allow the circle to be held out. The current induced in the wire sprang through the small air gap shunted by the handles, and powerful shocks were felt all around in the room, by means of this exploring instrument. When the area of the circle was compared with the area enclosed by the distant wire around the room, the effects were really remarkable.

Several motors were also on view, of the rotating field type, and single phase. There was one, of small dimensions, which served to count the oscillations, and which had been exhibited also at the World's Fair. Mr. Tesla touched incidentally on the advantages of the current curves employed in these machines, which are proportioned to the squares of the sines of the time. There are two such sine square curves superimposed in quadrature and Mr. Tesla commented on certain benefits obtained with such curves.

A great many other experiments were performed with static and electro dynamic induction, closing with the display of the vacuum tubes and phosphorescent bulbs lit up in the charged free spaces. Mr. Tesla frequently repeated the remark, which was obviously true to those who had seen his earlier experiments, that his oscillator is already proving of great value as a means of prosecuting further experiments and researches in the new field which he has opened up; while its promise of yielding great practical economy in the production of electricity is daily nearer realization. Among the advantages referred to were the ability of the machine to demonstrate the electro-magnetic theory of light, and its value as affording a crucial test of the Hertzian experiments and other investigations in that line. It may be added that besides the feature of running at almost any pressure, being, so to speak, frictionless, the most noteworthy fact to be appreciated by engineers is that when the piston vibrates at this great speed, and in spite of the high steam pressure, there is no packing on the piston whatever, and there is no leaking of the steam. As one watched the oscillator on Thursday evening, there was nothing to indicate that steam was present or was being used, except the steam gauge and its indication. The small boiler used by Mr. Tesla is one specially built for him by the Babcock & Wilcox Co., of their regular sectional type and tested up to 550 pounds. Mr. Tesla was really enthusiastic in praise of its working. The four arc lamps were of the Helios Company's make.

SOCIETY AND CLUB NOTES.

AMERICAN STREET RAILWAY ASSOCIATION.

THE thirteenth regular annual meeting of the American Street Railway Association will be held in Machinery Hall, Piedmont Park, Atlanta, Ga., Oct. 17, 18, 19. Headquarters, Hotel Aragon. Special Committees will report on the following subjects: "A Standard Form for Street Railway Accounts;" "Can the T Rail be Satisfactorily Used in Paved Streets?" "City and Suburban Electric Railways;" "Mail, Express and Freight Service on Street Railway Cars;" "Standards for Electric Street Railways;" "Street Car Wheels and Axles;" "The Best Method of Treating Accidents and Complaints;" "The T Rail Construction of the Terre Haute Street Railway Company," and "Transfers and Commutation." Notice has been received by the Secretary that special papers will be read on the following subjects: "A Practical System of Long Distance Electric Railway Work;" "Brake Shoes;" and "Destructive Arcing of 500 Volt Fuses."

An exhibition of all kinds of street railway supplies will be held in Machinery Hall from October 10 to 24 inclusive. The meeting room of the Association is in the same building so that members may readily examine the exhibits to the best advantage and without trouble. Applications for space may be made to Mr. N. W. L. Brown, Atlanta Consolidated Street Railway Company, Atlanta.

A number of entertainments have been provided, among which is a genuine Georgia barbecue.

All the Traffic Associations, except the Western Passenger Association, have authorized the sale of tickets at reduced rates—a fare and one-third for the round trip. This concession applies to all attending the meeting—delegates, supply dealers and accompanying friends. The Traffic Associations that have extended this courtesy are the Trunk Line Association, the Southern Passenger Association, the Central Traffic Association, the New York and Boston Lines Passenger Committee, the Boston Passenger Committee and the Railway Association of Michigan. Those in the East who desire to go to Atlanta via the Pennsylvania Railroad from New York to Washington, and over the Southern Railway from Washington to Atlanta, returning via Chattanooga, Paint Rock, Asheville and Salisbury, through the finest scenery in the Blue Ridge Mountains, will make application to R. D. Carpenter, General Agent, No. 271 Broadway, New York.

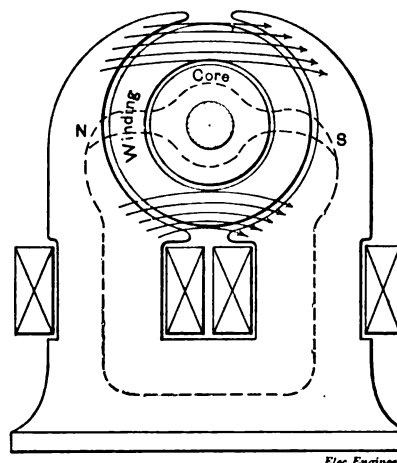
LETTERS TO THE EDITOR.

IRON WIRE FOR ARMATURES.

Referring to your editorial in the *ENGINEER* of Aug. 24, as far as field-magnet windings are concerned I do not think we need to discuss the question of employing iron wires. It is evident to any one familiar with dynamo electric machinery that iron wire would greatly increase the length of the magnetic circuit by reason of the enormous winding space required for the field spools.

Regarding armature windings we may first consider the winding of a toothed core. With this style of core we never find any difficulty in keeping the air gap reluctance as low as we possibly can have it in a good machine and there is consequently no need of any iron-wire. It would of course be ridiculous to make the teeth, or rather the spaces between the teeth, seven times larger than in an ordinary well-designed armature.

The second winding to be considered is the one employed on smooth cores. For a given diameter of core the height of an iron-wire winding would be at least six times that of an ordinary winding and we find, if we sketch it out on paper, that for such an armature the thickness of the winding will nearly equal the thickness of the core. It is, in my opinion, fair to assume that in such a case about 40 per cent. of the lines of force would never reach the core but would take the shorter way through the wind-



ing (see sketch). It would also be necessary to use stranded wire to minimize the loss from eddy-currents in the armature conductors. I am certain that the above points alone ought to counter-balance anything that might be said in favor of iron-wire windings.

NOTE: What do you suppose the "heads" at the ends of an armature would look like?

What would the "winder" say about handling seven times the quantity of wire?

ROBT. LUNDELL.

NEW YORK, Sept. 10, 1894.

THE INSURANCE VIEW OF INSURANCE.

In your issue of the 12th inst. I notice a letter from Mr. Geo. E. Coulson, Secretary and Treasurer of the Steelton Light, Heat and Power Co. of Steelton, Pa., with a foot note by you, relative to electric lighting and insurance.

Mr. Coulson has evidently been misinformed as to this Association demanding "25 per cent. additional on all premises where electric wires are used."

The Electric Light Co.'s agreement with this association is—that all electric work done by them will be in accordance with our rules and regulations, and in evidence of same they will "furnish the consumer and the owner of the building when requested a certificate upon the blanks furnished by the Association for such purpose."

Where current is supplied for electric work which does not conform to rules and regulations, the agreement states that "we will withhold the Association certificate until the same is made to conform to said rules and regulations."

Where the certificate can be given, no additional charge is made for the use of electricity, but where the certificate cannot be obtained, it is a notice to the Insurance Companies and consumer that the wiring is in a defective condition, and an additional charge of 25 per cent. is then demanded until same is in accordance with rules and regulations.

There cannot surely be any injustice in asking electric companies to carry out an agreement of this nature, it being simply a

business matter, that is to say, if a building is insured at a certain rate and an extra hazard, be it defective electric work, a defective flue, or boiler, storage of gasoline, etc., has developed it is reasonable to ask an extra premium.

It is certainly as much to the interest of the electric companies as to the insurance companies that the wiring be done in the safest possible manner, and if the consumer is given a guarantee (to which he is entitled, after paying his money), that it is in compliance with recognized rules for safety, there will be no "tendency to keep out the user," but rather a stimulant to the business, a sense of security felt by the consumer, and the cry of the electric company turned to "still they come."

We so frequently hear and see criticisms of the character above referred to based upon the ignorance of the critic, as to the real object of the rules and additional charges imposed by insurance companies. I feel that a statement of the insurance side of the case will lead many into a proper conception of the situation. The insurance companies are working with the electric companies to the end that electric lighting may become the ideal method of illumination, which from an insurance point means the safest, and with this end solely in view the regulations above referred to have been formulated for the mutual benefit of the consumer, the electric company and the insurance company.

ALFRED E. BRADDELL, *Inspector,*
Underwriter's Ass'n. Middle Dept.

PHILADELPHIA, Sept. 20, 1894.

IRON WIRES AS ARMATURE CONDUCTORS.

I notice considerable interest manifested in iron wire for armatures. I have had some experience in this matter which I will relate, as it may be of interest.

My object was to annihilate the air gap or reduce it to an inappreciable amount. I wound a drum armature with 208 rectangular iron bars separated by thin insulating strips. These bars were connected at the ends by copper wire cable to reduce the resistance. This was run in a multipolar field at a speed of 800 revs. By exciting the field gradually the magnetism could be carried up to a point that resulted in an E. M. F. of 75 volts, but beyond this the bars would be drawn out from the armature core, resulting in a whirr which the strongest bands of brass wire would not prevent.

The results which I secured were obtained at a cost of only 3,800 ampere-turns and to do the same thing in ordinary armatures would require about 5,000 ampere-turns so that, after all, the saving was not so great; but I had to increase the clearance so that the field would not pull the conductors to the pole faces. I think that if I could have held the bars firmly to the armature core, a desirable result could have been secured, but I was so disgusted that I threw it away without even putting a load upon it.

BOUND BROOK, N. J., Sept. 20, 1894.

OSBORN P. LOOMIS.

WANTED—A MACHINE FOR CUTTING UP IRON.

I AM cutting into scrap all the iron in the World's Fair ground, Jackson Park, and I was this day informed that there was an electric machine made that would cut or burn the iron faster than I am now doing. My informant said it was portable and that it could be handled and moved easily so as to get in, under and around the mass.

Can you or any of your readers give me any information about the machine?

W. W. COOLBAUGH.

6331 SHERRIDAN AVE., CHICAGO, ILL., Sept. 18, 1894.

NEW YORK ELECTRICAL SOCIETY.

THE members of the Society are informed that the photograph, taken by flash light, of the visitors to the Wild West show, is now ready and can be had on application to the photographer, Stacy, 450 Fifth ave., Brooklyn; price, 50 cents.

THE ASSOCIATED PRESS.

The last quarterly report of the Associated Press shows that it has 18,581 miles of leased wires, 168 operators, and 1,560 correspondents in this country. 400 newspapers receive its report directly. The average number of day words is 15,000 and of night words 45,000. The approximate number of words gathered throughout the country is 20,000 per day. A great many papers and associations also get the Associated Press news by way of sublease.

MARBLEHEAD, MASS.—The Electric Lighting Committee has awarded a contract for piping for \$3,000 for the electric light station, to the Walworth Construction and Supply Co. of Boston.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED SEPTEMBER 25, 1894.

Alarms and Signals:

Electric Signal Apparatus, W. W. Salmon, Chicago, Ill., 526,414. Filed Feb. 1, 1894.

An automatic electric block signal system for steam railways.

Electric Signal Apparatus, W. W. Salmon, Chicago, Ill., 526,415. Filed Feb. 1, 1894.

Similar to No. 526,414

Electrical Cab Signal for Railways, E. C. Wiley, Bristol, Tenn., 526,508. Filed Jan. 31, 1894.

Submarine Signaling, L. I. Blake, Lawrence, Mass., 526,609. Filed July 6, 1894.

Especially adapted for telephonic communications with light ships.

Conductors, Conduits and Insulators:—

Insulator for Electric Conductors, G. Webster, Philadelphia, Pa., 526,472. Filed July 26, 1894.

Employs a curved groove adapted to hold a taut wire in place without tie wires.

Conductor Support and Insulator, D. N. Osyor, Columbus, O., 526,498. Filed Nov. 29, 1893.

Employs a duct extending through the supporting spool for carrying away moisture.

Dynamos and Motors:—

Means for Driving Dynamos from Car Axles, W. Biddle, Brooklyn, N. Y., 526,432. Filed Oct. 20, 1893.

Relates especially to the method of supporting the generator upon the railway truck and gearing it to the axle.

Voltage Regulator for Dynamos, M. P. Ryder, New York, 526,588. Filed May 12, 1894.

Employs a circuit breaker actuated by the armature and comprising a slide plate, a conducting block insulated thereon, and conducting springs secured to a stationary support and making contact with the conducting plate.

Measurement:—

Electrical Measuring Instrument, H. Herberts, Schenectady, N. Y., 526,487. Filed March 5, 1894.

Provides means for sending the current to be measured in two electrically parallel branches around the needle or armature of the instrument, thus exciting two distinct polarities in the latter.

Metal Working:—

Joint for and Method of Joining Metal Bars, W. M. Brown, Johnstown, Pa., 526,434. Filed March 23, 1894.

Employs a welding chock adapted to engage the web and extremities of the flange and head of the rail and weld thereto.

Miscellaneous:—

Apparatus for Electrodepositing, H. L. Bridgman, Blue Island, Ill., 526,483. Filed Oct. 3, 1893.

Attachment for Speaking Tubes, W. Weber, Philadelphia, Pa., 526,549. Filed Dec. 30, 1893.

Railways and Appliances:—

Conduit for Electric Railways, D. F. Graham, Springfield, O. & W. P. Allen, Chicago, Ill., 526,392. Filed Oct. 25, 1893.

Employs a pivoted box within the conduit containing a metallic contact plate and a plunger also provided with a contact plate and pivoted to a hinged plate in the conduit, which latter serves the purpose of protecting the conductors and is only raised during the passage of the car.

Bracket for Trolley Wires, L. S. Pfouts, Canton, Ohio, 526,408. Filed Dec. 30, 1893.

Trolley and Feed Wire Bracket, L. S. Pfouts, Canton, Ohio, 526,409. Filed Jan. 11, 1894.

Trolley Wire Hanger, I. B. Walker, Sioux City, Iowa, 526,422. Filed Feb. 26, 1894.

Consists of a single piece with a central lip grooved upon its upper surface for the reception of the trolley wire and arms grooved upon their lower surfaces and extending beyond the ends of the lip.

Closed Circuits for Electric Railways, C. D. Tisdale, Boston, Mass., 526,468. Filed Sept. 4, 1893.

Consists of a flexible tube supporting the auxiliary conductor along its top and furnished with inwardly projecting ribs for retaining the main conductor in position.

Trolley for Electric Conductors, D. N. Osyor, Columbus, Ohio, 526,580. Filed Dec. 6, 1893.

Employs two sets of trolley wheels mounted upon a carriage running between two parallel trolley wires.

Testing Indicator for Electric Railway Cars, T. Stebbins, Boston, Mass., 526,644. Filed Aug. 21, 1890.

Employs a switch apparatus and connection whereby a test indicator may be applied so as to form a shunt around any part of the apparatus to be tested, as for instance the various circuits of a railway motor.

Switches and Cut-Outs:—

Electrical Safety Fuse, O. M. Rau, Milwaukee, Wis., 526,502. Filed Oct. 31, 1893.

Claim 1 follows:—

An electric fuse constructed with a series of turns or coils lying in close proximity to each other.

Rheostat, B. E. Baker, New Britain, Conn., 526,605. Filed June 4, 1894.

Claim 1 follows:—

A rheostat consisting of cores having resistance wires wound around them, blocks of plastic material in which the cores are embedded and suitable clamping devices by which the blocks are retained in operative position.

OBITUARY.

MR. J. ENGLISH.

We regret to note the death at New Haven of Mr. J. English, treasurer of the Bridgeport, Conn., Electric Light Co. Mr. English has long been prominent in electric lighting matters and served as an officer of the National Electric Light Association. He leaves a wife and three children. He was a nephew of the late Governor English of Connecticut.

Trade Notes and Novelties

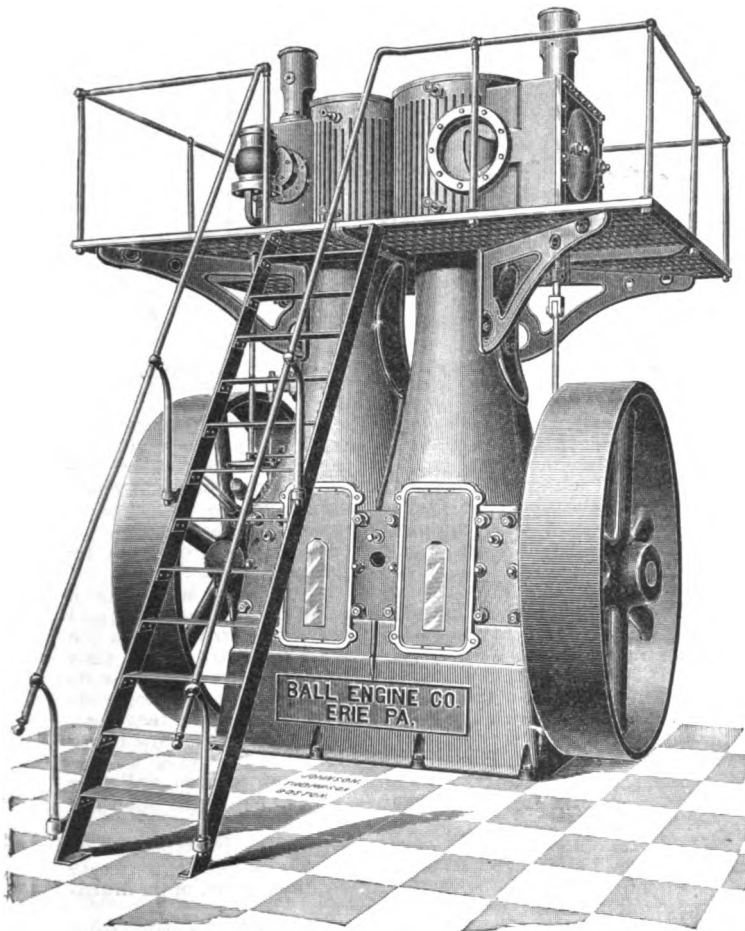
AND MECHANICAL DEPARTMENT.

THE NEW VERTICAL BALL ENGINE.

The Ball Engine Co., of Erie, Pa., have designed the vertical engine shown in the accompanying illustration with special reference to electric light work.

It was desired to arrange an engine whose structure should be of such a form that the main pieces should be absolutely rigid and indestructible, and whose steam distribution should be symmetrical on both sides of all the pistons, whether one, two, three, or four are used; in other words, an independent valve motion for each cylinder employed, and each of these being a perfect engine in itself.

By reference to the illustration it will be seen that the main proposition as to strength and indestructibility is covered in the symmetrical form of the upright housings which are made to constitute one double housing by having one side of each planed



NEW VERTICAL BALL ENGINE.

and bolted together in the centre of the middle shaft bearing. This substantiality is still further increased by the operation of planing the bottom of both housings to one continuous flat surface to meet the planed surface of the top of the single base plate to which the bottoms of the housings are substantially bolted. The introduction of the shaft is accomplished by arranging the shaft boxes in a large jaw cutting into one side of the housing deep enough to bring the centre of the shaft in a plane with the centre of the housing, finish spots being provided to meet correspondingly finished surfaces upon the cast iron boxes.

Each housing is also pierced by a large rectangular opening on each side (shown covered by a door bolted on) extending both high and low enough to allow the cranks with their counterbalancing discs to pass. Hence, with shaft, boxes and struts in place to close up the engine, it is only necessary to put up and secure the large doors, which in turn are provided with a small shutter plate covering an opening large enough for the insertion of one's hand to feel the connecting rod strap when the engine is in motion and the necessary wrenches to key up the crank boxes when so desired,—while the adjustment of the journal boxes is accomplished by turning the three set screws shown in each strut,

—the two in the centre reaching the quarter boxes while the third one above operates either in or out a wedge which fills between the upper side of the jaw in housing and the top box; thus giving independent adjustment for three parts of each box while the lower box is perfectly free to move at right angles to the axis of shaft, thereby giving for all positions of adjustment of the quarter boxes a full bearing for the shaft.

The shaft is of one piece of forged steel from end to end, the crank pins being 180 degrees apart and cut out of the solid down to their round diameter, and as are the journals, ground to a perfectly round smooth running surface. The pins are provided with centrifugal oiling holes in addition to the regular supply through the usual tube reaching from the upper to the lower end of connecting rod.

The connecting rods are of forged steel, the crossheads are of the double plate pocket type, as used in many makes of Corliss engines, the piston rods are of crucible steel, screwed into the crosshead, and the pistons are of the double plate type, held up to a solid collar and taper by a well fitted nut. The piston packing is made up of two self-adjusting parted rings and a broad junk ring for centering and guiding the piston in the cylinder.

The cylinders are of charcoal iron mixed in such proportion of hard and soft as to produce a very strong, close-grained iron which enables the surfaces to take a mirror polish. They are provided with single valves, each of which is practically one piece so far as the motion and wear are concerned.

The high pressure valve is of the double faced telescopic relief type, while the low pressure valve is of the common letter D type provided with a round relief area upon its back operating against the chest cover, thus giving a large, well proportioned valve that runs with the greatest ease and yet follows up its wear without attention from the outside.

Indicator diagrams show that where single valves of proper design are used the steam distribution can be made so perfect that it is simply folly to continue the chase after an ideal perfection that involves a vast amount of complication at an increase of first cost, maintenance, and continuous attention, which is not justified by the results obtained.

This engine is employed in electric railroad work and is supplied with steam at 125 pounds gauge pressure. It exhausts into a practically uniform vacuum of 24", and was driving (at the time the test for total variation from standard speed was made) 425 to 435 indicated horse-power. To observe the variation a tachometer was attached to the main shaft. When all was in readiness and the full load was on, the switch controlling the whole current leaving the station was opened, thus dropping the entire load instantly, and the engine made a momentary flutter up to 285 revolutions and back again to 233 revolutions. The circuit was kept open while the attendant counted ten and was closed as suddenly as it had previously been opened, when the tachometer showed the engine making the same momentary flutter down to 281 revolutions and back again to 233, taking up instantly a load of about 400 indicated horse-power.

The engine is guaranteed not to vary in speed from full load to no load, and vice versa, more than one per cent., hence as the test showed but eighty-six one-hundredths of one per cent., it was conceded that the guarantee was fulfilled in very good form.

The outward appearance of the engine is neat, symmetrical, and at once demonstrates that in this arrangement has been, accomplished a great reduction of floor space required for this amount of power.

THE VARLEY BUG-PROOF BELL.

The race of bugs which, according to nursery rhyme, was supposed to be happily domiciled in some convenient rug, or rug, has apparently died out or else has cancelled its lease on rugs properties and moved to mansions higher up on the wall. Any bell hanger who has gingerly jabbed bugs out of a bell and chased them out of annunciator cases, will readily concur in the idea of this supposed exodus. Of late years it has been the constant effort, with manufacturers to construct a style of bell that would effectually bar these unwelcome tenants. But the bugs have always roosted around the cheerful blaze of the contact points just the same. In the Varley bell, this single vulnerable point has been ingeniously protected by a small elastic covering that completely encloses the solid platinum contacts but does not in the least restrict the free vibration of the clapper. The bell being, otherwise, of the open frame construction there are no inviting nooks where bugs will gather. The magnets are duplex wound and so arranged that the armature gets the full benefit of the "pull" and can be operated with much less battery than needed with an ordinary bell. All adjustment screws have lock-nuts so that they cannot work loose. The Central Electric Company, 173-175 Adams St., Chicago, are making it one of their specialties and report a very satisfactory demand from dealers who buy the better grades of electrical merchandise.

MR. JAMES H. BATES, M. E., has opened an office as consulting and constructing engineer for street railways, central stations, isolated plants, etc., at 126 Liberty street.

WARREN WEBSTER & CO.

WARREN WEBSTER & CO., Camden, N. J., specialists in examining steam plants where economy in fuel is desired, by utilizing the waste exhaust steam, report considerable activity in their business, owing to the better appreciation of their manufactures in comparison with the standard apparatus for similar purposes. Among the recent contracts for the Webster "Vacuum" feed water heater and purifier they mention:—B. & O. Tunnel Plant, Baltimore, Md., 3,000 H. P.; Westinghouse Electric and Manufacturing Co., Brinton, Pa., 2,500 H. P.; Pennsylvania Bolt and Nut Co., Lebanon, Pa., two 1,000 H. P.; Berwick Electric Light Co., Berwick, Pa., 250 H. P.; Whitall, Tatum & Co., Millville, N. J., 400 H. P.; Baker Chain and Wagon Iron Mfg. Co., Allegheny City, Pa., 250 H. P.; The Samuel Winslow Skate Manufacturing Co., Worcester, Mass., 400 H. P.; Cincinnati Street Railway Co., Cincinnati, O., 1,000 H. P.; Arapahoe Street Railway Co., Denver, Col., 150 H. P.; Erie Chemical Co., Erie, Pa., 150 H. P.; Pittsburgh Tin Plate Co., Kensington, Pa., 400 H. P.; City of Boston, one special machine; Snow Steam Pump Co., Buffalo, N. Y., 100 H. P.; Henry Wanklin, Roxborough, Pa., 60 H. P.; Fairfield Paper Co., Fairfield, Mass., 600 H. P.; Chicago Edison Co., North Side Station, Chicago, Ill., 2,000 H. P.; The Johnson Co., Lorain, O., 8,000 H. P.; Philadelphia Gas Co., two 600 H. P.; Philadelphia Gas Co., 500 H. P.

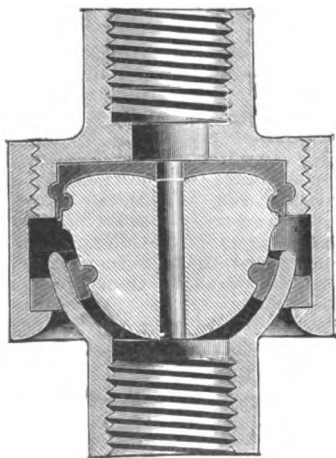
Numerous orders were also received for the Webster Separators and the Williams Vacuum System of Steam Heating.

THE PITTSBURGH INSULATING JOINT.

The accompanying illustration shows in section a very cleverly arranged and designed insulating joint made by the Supply Manufacturing Company, of Pittsburgh.

It has a porcelain insulator with a metallic packing ring, which, in connection with a concavo-convex flange bearing upon it, forms a non-corrosive, gas-tight joint which comes apart by unscrewing a lock nut and allows one-half to be screwed to the gas-pipe, and the other half to the chandelier, thus doing away with the revolving chandelier and avoiding the danger of stripping threads, as sometimes happens with solid joints.

The chandelier is held stationary while being coupled, and as the concavo-convex bearing flange is adjustable, a chandelier can be hung perfectly plumb even if the gas pipe is not at right angles to the ceiling, which is very often the case. The size of the joint



THE PITTSBURGH INSULATING JOINT.

as a whole is standard, but the connecting parts are made in sizes of from $\frac{1}{4}$ to $\frac{1}{2}$ inch.

The device is neatly made in a most workmanlike manner, and is so simple as to commend itself to the trade.

NORWICH INSULATED WIRE CO.

THE new catalogue of the Norwich Insulated Wire Co., of 44 Broad street, this city, is beautifully gotten up and its illustrations are unique. The latter are fac simile reproductions in size and color of the cables they represent, and are executed in four printings. The copper wire, the paper insulation, and the lead sheathing or braided covering are all most naturally reproduced, and sections of cable from the smallest up to 2,000,000 c. m. feeders are shown, as well as telegraph and telephone cables in great variety.

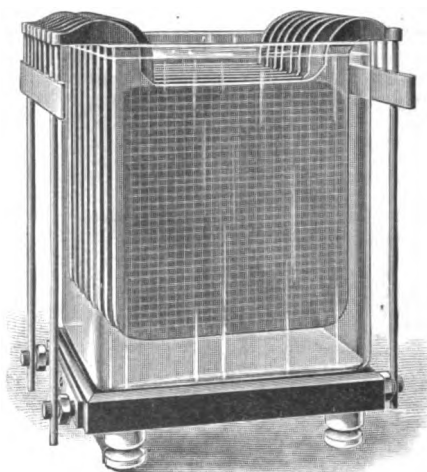
It is claimed by the company that in the manufacture of these cables none but the highest grade copper is used, showing a conductivity of 99.50%, all of which is carefully tested in its various

stages of manufacture, that the insulation is chemically pure and is not affected by acids, heat or cold, and that the lead is 99.9% pure, insuring the greatest evenness in covering, and keeping the sheath free from "pin-holes."

Mr. E. W. Stevenson has recently become the electrician of the company.

THE ACCUMULATOR COMPANY'S NEW "I. P." TYPE CELL.

The Accumulator Company, of 234 Chestnut St., Philadelphia, have just brought out their new "I. P." independent-plate type of cell which embodies a number of valuable features which will not fail to be appreciated by users of storage batteries.



ACCUMULATOR COMPANY'S NEW "I. P." TYPE CELL.

This new cell which is shown in the accompanying engraving is so arranged that each plate is mechanically independent of every other plate, and may be lifted partly or wholly out of the containing cell without disturbing any of the other plates or their connections. By this means it becomes possible to inspect each plate at will without interrupting the current on the circuits. A plate can thus be cleaned, replaced, straightened, or even repasted, if necessary, and with little or no trouble.

This construction of course made it necessary to devise a special method of connection between the plates of one cell and those of another, and this has been very neatly carried out in the new terminal adopted. This consists of a copper bar drilled with holes filled with mercury into which dip short copper rods attached to the lugs on the battery plates. The connecting rods of one cell alternate with the rods of its neighbor in the terminal. In the case of very large cells of this type, such as are now being installed in several buildings in New York the plates as well as the copper connecting bar are suspended on stands built up between the containing cells so that no weight can come upon the latter.

The system is exceedingly elastic, as, by the introduction of additional plates, the capacity of the battery at a twelve hour rate is 50 ampere hour units, or in 15 ampere hour units, or in multiples of these may be increased as required.

The plates are suspended from the top of the jar, thus uniformly distributing the weight in the best possible manner. In the older types the entire weight of the battery rested upon three or four points, subjecting not only the piles but also the containing box or glass jar to uneven strains. The plates are freely suspended in the liquid from a support at the top, and are free to expand or contract in any direction, thus obviating the chief cause of buckling.

The system it will thus be seen possesses at least three very distinct advantages. 1. The resistance of lugs and contacts is reduced to practically nothing; (2) Repairs can be effected at much lower cost than if all the plates of similar polarity in a cell are burned or bolted together into a section; and (3) no stoppage of the battery is required while making repairs or examining the plates.

The Accumulator Company manufacture these cells in sizes up to 12,000 ampere-hour capacity, thus making them adapted to both isolated as well as central station work.

THE PITTSBURGH REDUCTION CO., manufacturers of aluminum, have opened an office in New York on the ground floor of the Havemeyer Building, corner of Church and Dey streets. The office is in charge of Mr. James C. McGuire, agent and consulting engineer.

Digitized by Google

WESTERN NOTES.

THE MAGNETIC TELEPHONE CO., Oak Park, Ill., has been incorporated with a stock of \$100,000 by D. J. Kennedy, Henry E. Pocunier and Geo. W. Wildon.

MR. GEO. L. THAYER, the well known electrical engineer of Chicago, has moved to Belle Plain Ia., where he will act as superintendent of the electric light and power station.

THE GROSSDALE LIGHT & WATERWORKS CO. has been incorporated at Grossdale, Ill. with a capital stock of \$500,000, by W. Melville, Oscar E. Taylor, Paine Harrington and others.

LT. SAMUEL REBER, U. S. A., who was one of the World's Fair judges, department of electricity, also secretary of one of the sections of the Electrical Congress, has been transferred to Ft. Reilly, Kansas.

PACIFIC, MO. A twenty years electric light franchise has been granted to Mr. W. E. Bailey, and a company with a capital stock of \$8000, was organized at once. Work on the plant will begin immediately.

GRIER BROTHERS, western managers for the Bryant Electric Company, Chicago, have issued a neat little folder with illustrations of articles that have recently been placed upon the market by their company.

MR. D. P. PERRY, the well known president of the Standard Electric Company, Chicago, who has been confined to his home by an attack of pneumonia, is much improved and will soon be able to be at his desk.

MR. W. E. PARKER, who has been in Chicago during the last three months in the interest of the F. P. Little Electric Construction Co., has returned to Buffalo, N. Y., and will be missed by a number of friends.

MR. GEO. C. KUNTZ, formerly general sales manager for Duerr & Rohn, Milwaukee, is now with Osburn Bros. Chicago, in a similar capacity and with his wide experience in the electrical field will be sure to prove a valuable acquisition to that firm.

ELECTRIC LIGHT PLANTS, THEIR COST AND OPERATION, is the title of a valuable book just published by Mr. W. J. Buckley of the Fort Wayne corporation. All who are in any way connected with electric light and power plants will do well to send for a copy of the book.

CROOKSTON, MINN. The Telephone exchange recently completed by Mr. Ed. Plowman, continues to give the most perfect satisfaction. The D'Unger apparatus is used. Mr. Plowman is now building a 28 mile toll line and will soon commence work on a line 108 miles in length.

THE JENNEY ELECTRIC CONDUIT COMPANY has been incorporated with a capital stock of \$5,000,000 by L. A. Farnsworth, Jos. M. Hill and Chas. S. Marshall. The company will exploit recent patents issued to Mr. Jenney, covering several new and important features in underground conduits.

MR. W. O. MEISSNER, General Manager of the Washington Electric Company, Chicago, has just returned from a trip to Pittsburgh, where he looked after the proper starting of a number of focussing lamps recently shipped there. Mr. Meissner reports the outlook for business in all its branches as very encouraging indeed.

MR. HERBERT WADSWORTH who will be remembered from his connection with the Excelsior Electric Company, and later with the General Electric Company, Chicago, was in the city last week shaking hands with old friends. Mr. Wadsworth is now located in Riverton, Alabama, acting as receiver for some extensive railway properties.

THE NEW YORK INSULATED WIRE COMPANY, Chicago Office, report a good demand for Grimshaw White Core Flexible Cable for switchboard use. They also report the business as keeping well up with last year's sales. The demand for No. 14 B. & S. wire is very strong and a large invoice of this size has just been received from the factory.

THE METROPOLITAN ELECTRIC COMPANY, 186-188 Fifth avenue, report business as good and the receipt of several large orders for wire and construction material and new plants entire. The Metropolitan Company have recently gotten in a large consignment of special split locust pins for high class electric light and railway work and are ready to fill orders promptly for these goods. Their N. I. R. Wire is universally called for and sales in this line are increasing. The Company are announcing to their patrons that they are handling the Kester Monarch arc lamp, representing the F. P. Little Electrical Construction and Supply Company, makers of this lamp in the West, Mr. W. E. Parker having returned to Buffalo, having had this line in charge during the Summer months with headquarters with the Metropolitan Electric Company. A stock of these lamps are kept on hand in alternating, direct and constant current, ornamental and otherwise.

MR. GEO. M. WATSON, well known in electrical circles, died in Chicago on the 7th inst. Mr. Watson was for many years in charge of the accounting department of the old Electrical Supply Co., and served in a similar capacity with other firms.

A TWO WIRE 220 VOLT SYSTEM has been in operation for some time at Evart, Michigan, with so far excellent results. The plant consists of a 45 k. w. multipolar Standard generator running at 280 volts, the lamps being 280 volts, single filaments. The plant is owned and operated by the city and was installed according to the specification of Mr. Frank B. Rao.

THE JENNEY ELECTRIC MOTOR COMPANY have just closed a contract, through their Cleveland representative, for sixty special small motors for operating looms in the works of the W. S. Tyler Wire Works Co., Cleveland. There were a number of sample motors submitted for trial, and the Jenney motor was selected on account of its superior showing after a very severe test.

MR. GEORGE T. SIMPSON, of Hamilton, Ontario, a prominent manufacturer of transformers, visited Chicago last week to arrange for the purchase of a car load of magnet wire and other supplies. Mr. Simpson states that Canadian electrical manufacturers prefer to use American magnet wire, owing to its superior qualities, even though the price is slightly higher than their home product.

THE ELECTRIC APPLIANCE COMPANY, are having a large sale of their standard single push flush switch made up in gangs of from two to a dozen on a single large face plate for special work where a handsome finish is expected. As the single pole, 8 way and commutation switches are all the same size, they can be mounted very symmetrically, several on a single large face plate, and when the plate is finished specially to match hardware or fixtures, a beautiful piece of work is secured.

THE METROPOLITAN ELECTRIC COMPANY have taken the agency for the Commercial Electric Company's dynamos and motors, and carry a large stock from which to fill orders promptly. One of the important agencies that the Metropolitan Electric Company list is the Royal transformer. These transformers are being made especially for the Metropolitan Electric Company. As soon as possible, they will carry a full stock. They are now booking orders and have found a ready demand for a good transformer in all sections of the country.

MR. JNO. R. MARKLE, Manager of the Western Department Office of the Electric Storage Battery Co., announces the sale to the Merrill Railway & Lighting Co. of Merrill, Wis., of a storage equipment of 240 kilowatts capacity. This is to be used in conjunction with the street railway generator at present in use, and also supply a number of street lights which are run five in series. This is the first combination in this country of a storage battery with street railway plant, and the results will be watched with great interest by progressive street car men.

THE D'UNGER LONG DISTANCE TELEPHONE CO. will have a beautiful exhibit at the coming Pittsburgh Exposition, consisting of a complete miniature telephone exchange in working order. The instruments and accessory apparatus were manufactured by J. D. Price of the Franklin Electrical Works, Chicago, and show a most beautiful workmanship, even in the smallest details. Messrs. McKee Bros. of Pittsburgh will have charge of the exhibit. They are exploiting the D'Unger Telephones in the Western half of Pennsylvania, and have already secured franchises for two towns with prospects of additional ones.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. The meeting of the western members was held at Armour Institute, Chicago, last Wednesday evening, simultaneously with the 89th meeting in New York. An audience of nearly 100 was present, Prof. Stine, acting as chairman, read a telegram from secretary Pope, appointing Mr. B. J. Arnold Local Secretary. The chairman then introduced Mr. L. H. Rogers of the Sperry Electric Brake, who presented Mr. Sperry's paper entitled, "The Electric Brake in Practice." The reading of the paper was closely followed by the audience, and at its conclusion was greeted with much applause. A lively discussion then ensued, being participated in by Messrs. Arnold, Grier, Kammeyer, Drake, Rogers, Norton, Dr. Lobach, Prof. Stine and others. On motion of Mr. Arnold, a vote of thanks was tendered to Messrs. Rogers and Sperry which was carried unanimously. On account of lack of time, the paper by Messrs. Bedell and Kinsley was not read or discussed. A number of applications for membership were received by the Local Secretary, after which the meeting adjourned.

Departmental Items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE Electrical Engineer.

Vol. XVIII.

OCTOBER 10, 1894.

No. 336.

A SIMPLE FORMULA FOR MAGNETIC WINDINGS.

BY

Fred B. Conrad Corp.

SEVERAL methods have recently been presented for the calculation of the windings of magnets, and for the determination of the proper size of wire for each particular case. Perhaps a simple formula, devised by the writer for use in his own work, might be of interest to others who have frequently to calculate the field windings for electrical machinery. The formula is applicable only to shunt or separately excited machines. It is possible that others have followed the same method but those to whom it is new will find it extremely useful.

Supposing each turn of the winding to be of the same length, the number of ampere-turns depends only upon the cross-section of the wire used, and hence, to obtain a given number of ampere-turns on any core it is only necessary to select the proper size of wire.

The resistance of one circular mil foot of copper wire at a temperature of 100 degs. Fahrenheit is approximately 11 ohms, and for all ordinary field windings this value may be considered sufficiently accurate. The resistance of any piece of copper wire at this temperature is therefore,

$$R = \frac{11 \times L}{\text{circ. mils}},$$

where L is the length of the wire expressed in feet. The current flowing in any such wire is evidently,

$$C = \frac{\text{E. M. F.} \times \text{circ. mils}}{11 \times L}.$$

It is also evident that the number of ampere-turns in any winding is numerically equal to the number of amperes that would result if a single turn of wire were subjected to the voltage to be used, hence,

$$\text{Ampere-turns} = \frac{\text{E. M. F.} \times \text{circ. mils}}{11 \times l},$$

where l represents the mean length of one turn in feet. We now have, by transposition, the cross section of the wire for the required winding:

$$\text{Circular mils} = \frac{\text{Ampere-turns} \times 11 \times l}{\text{E. M. F.}},$$

In case the winding is to be applied to a shunt motor without external field regulation the above is of course sufficient, but in other cases allowance must be made for whatever regulating resistances are introduced into the field circuit.

This, however, is a very simple matter when once we have determined the ratio of the regulating resistance to the resistance of the magnet winding. It is then necessary only to increase the above result in that ratio to obtain the

necessary increase in the cross-section of the wire to be used.

Suppose that we have assumed the ratio $r : R$ as the correct value for the required regulation. Then our formula becomes,

$$\text{Circular mils} = \left(\frac{\text{Ampere-turns} \times 11 \times l}{\text{E. M. F.}} \right) \left(\frac{R + r}{R} \right)$$

The mean length of turn can generally be readily estimated with sufficient accuracy to insure very reliable results.

We can now select the size of wire whose cross-section is nearest to the correct value as found above, and determine the amount of wire to be used by any of the various rules which have been suggested for economy of wire and safe limits of heating.

This question of heating is of course a matter of prime importance and unfortunately it is impossible to devise any rule or formula that will, even approximately, give the desired results. The rule is often given to allow one square inch of radiating surface per watt consumed in the coils, but the application of this rule must be governed not only by the shape of the coil and of the surrounding iron, but also by the insulation on the wire, the outer covering of the coils and the material of the supporting spool. It is however a simple matter in the construction of a machine, to determine the heating effect of the field current by experiment, and then add or subtract wire as seems best for satisfactory working.

ELECTRICAL MACHINIST PRACTICE.—IV.

BY

James F. Hobart,

Among the several methods met with in practice, of fastening the armature terminal wires to the commutator, none seems to be better than the "set-screw method." It is true that the armature terminals perfectly soldered to the segments, form a very good, and almost perfect means of doing the required work, but in case of overheating, the solder is the first thing to fail. Bad soldering is worse than almost any other form of connection, and bad soldering has also the disadvantage being so hidden that careful search with delicate testing instruments is necessary for its detection. After starting, however, the trouble is easily found, but the cause is not always easily brought to light.

The set-screw commutator fastening seems a more mechanical way of making connections which are liable to be taken down at any time. Set-screws do sometimes work loose and cause trouble in that way, but a liberal coating of shellac, paint, or other plastic material, applied to the heads of the set-screws, firmly locks them in position, so much so that it is frequently necessary to clip off the coating with a cold chisel before the socket wrench can be applied to the screw heads.

To properly attach the ends of the armature coils to the

commutator segments, it is necessary that a loop or eye be formed on the end of every connection which is to be attached to the commutator. Simply bending the end of the wire into a loop, and putting the set screw through the eye thus formed, will not make a safe job. A flat piece of copper must be attached to the end of each connecting wire, and a hole made in the plate to receive the set-screw. Such a construction is shown at *d*, Fig. 16.

The method of construction is also shown by the engraving. The bit of copper tubing, *a*, is just large enough to fit snugly on the wire *b*, which is shown with the insulation cut back for a distance from the end. The tube is slipped on the wire and flattened down, as shown at *c*. The next step is to make the hole, and bend the copper plate, as at *d*. The flattening may be done at a single operation, and the bending and hole-making completed at another operation, no tools but a drop press, or a simple hammer being necessary.

Fig. 17 shows a swage for putting the tube and wire together. The steel block *e* has a groove cut in the top

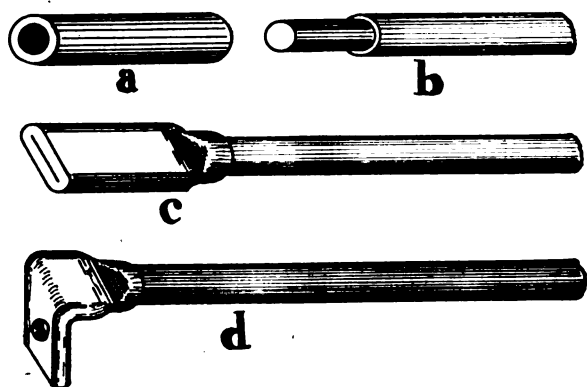


FIG. 16.

exactly as wide and deep as the plate *c*, Fig. 16, is to be when finished. This swage, or jig, can be fastened to the anvil of a drop press by means of the projecting lug at the bottom. If no drop press is at hand, the lug may be screwed in an ordinary vise; and the tubes put on the wires by simply laying them in as shown at *f*, and then hammering the metal down even with the cheeks of the jig. The pin shown in the middle of the channel, is a stop to regulate the length of the flattened portion of the connection. By putting together the two parts in this manner, very perfect connection is formed, as the parts are both dovetailed and riveted together. There is no such thing as pulling them apart without destroying them for dynamo use.

The bending and punching may be done at a single operation, and with one blow of the hammer, by means of

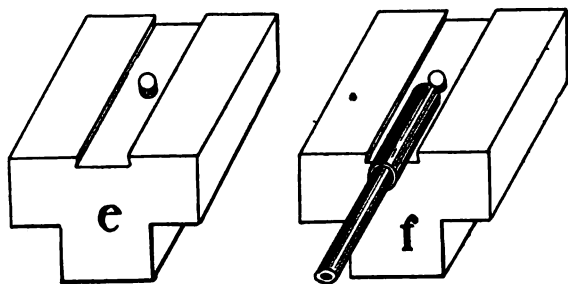


FIG. 17.

the tools shown by Figs. 18 and 19. The operation can also be performed in a press, either "squeeze," or drop. In Fig. 18, the hole *b* is deep enough to admit the flattened tube as far as the bend *d* Fig. 16. The punch, Fig. 19, is then put into the die, the block *b b* being guided by the

grooves *a a* Fig. 18. Besides guiding the punch into the hole *c* the block *b b*, Fig. 19, also does the bending. The shallow oval groove *e* engages the flattened wire and

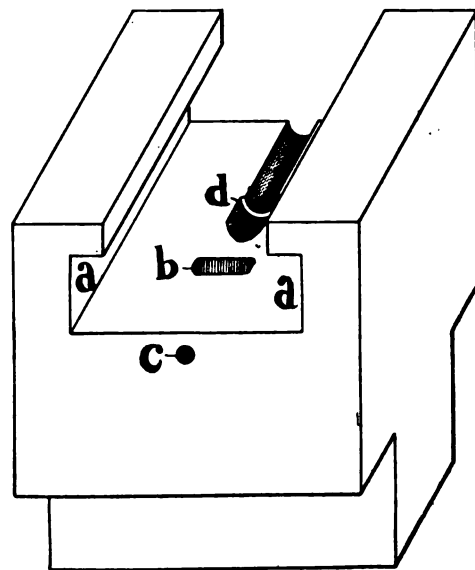


FIG. 18.

forces it down. As the travel of the punch proceeds, the round part of the tube and of the wire is forced down into the bed *d*, Fig. 18, made to fit it.

The block *b b*, Fig. 19, is broken away in order to show the steel punch *d*, which enters hole *c*, Fig. 18, and as it comes against the flattened tube in the hole *b*, every connection must have its hole punched exactly like all the others. A special machine can easily be arranged for operating this die and punch, but for small lots, say several hundreds, or even thousands of connections, the vise and hand hammer method answers very well and is quite

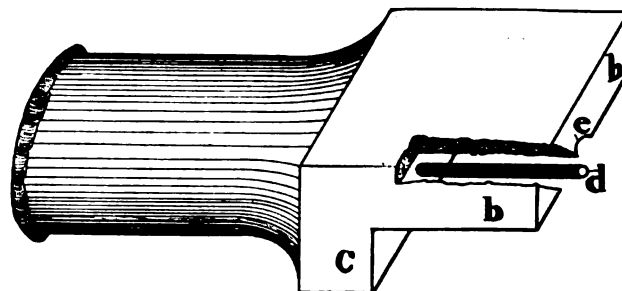


FIG. 19.

economical. One man to operate the punch and hammer, with a boy to insert and remove the wires, can make in a single day, a surprisingly large number of these connections.

"Jigs" can be employed to very great advantage in electrical machine work. Indeed, there is hardly an operation to which many pieces have to be subjected where one or more good jigs may not be applied to advantage. Take, for example, the slotting or grooving of the brasses, both top and bottom, used in dynamo and motor armature bearings. The jig used is a casting made something like the cast-iron box which contains the brass, but the bottom of the casting is made flat, and with flanges so that it can be bolted to the table of a plain Brown & Sharp milling machine. Two bolts hold the jig firmly to the machine table, and a single bolt actuates a clip which clamps the flange or collar of the brass, and thus secures it to the jig.

A circular mill or cutter 5 inches in diameter by $\frac{5}{16}$ inch thick, is used for cutting the oil groove. This diameter of

mill is necessary in order that the arbor may clear the sides of the brass. A pair of stops are rigged on the feed apparatus of the milling machine. The carriage is brought to the first stop, after a brass has been placed in the jig and clamped fast. The vertical feed is run down to another stop, which regulates the depth of cut, about $\frac{1}{8}$ inch, then the power feed is put on, the carriage travels to the second stop, and stops, and the cutter is raised again, another brass put in place of the finished one, the carriage returned to the first stop, and the operation repeated. The oil grooves cannot fail to all come out alike under such treatment.

The boring of solid boxes and babbitt lined boxes also, should have a jig, or perhaps it should be called a special machine, for that purpose alone. An old milling machine, can be easily made into a box boring machine, the cutters being inserted in a boring box, and only bits, or cutters from one to two inches long, and $\frac{3}{8}$ to $\frac{1}{2}$ inch square are necessary. A set of jigs for clamping the boxes, should be made. These jigs should be made in two castings each, and hinged together so that the top one may be turned back, a box inserted, and the top replaced and secured with a bolt. The box is then ready for the boring bar, no adjusting being necessary, and the jig doing everything automatically when the box is placed in it.

The finish put upon a piece of exposed brass, or cast iron, often has a good deal to do with the desirability of a machine, or piece of apparatus. Especially is this true on large flat brass, or iron surfaces which must be finished bright. To vary the monotony of such surfaces, a variety of engraving, or "tooling," may be executed in an ordinary drill press, which does a good deal toward removing the plain appearance, and may be easily accomplished as follows: Turn up in a speed lathe, a hard wood stick $\frac{1}{2}$ or $\frac{3}{8}$ inch in diameter, and from 3 to 12 inches long, according to the work to be done. The shorter the stick, the more satisfactory its work. Put the stick in the drill press; touch the lower end of the stick with oil and emery, and trace the desired pattern on the brass. The end of stick may be turned down to give any desired width of cut, the effect much resembles genuine scraper work.

MAGNETIC LEAKAGE IN DYNAMO-ELECTRIC MACHINERY.—V.

BY

Alfred E. Wiener.

D. Comparison of Various Types of Dynamos.

In order to illustrate the application of the above formulæ, and at the same time to afford the means of comparing the relative leakages in various well-known types of dynamos, in the following frames of various types are designed for the same armature, and the leakage-factor for each machine thus obtained is calculated.

In order to accommodate all the types to be considered here, the armature has been chosen of a square cross-section, viz., 16 inches core-diameter, and 16 inches long. This armature, if wound to a height of about $\frac{5}{8}$ inch, and driven at a speed of 800 revolutions per minute, will yield an output of 50 kilowatts.

The polepieces for this armature must have a bore of $17\frac{1}{2}$ inches, and must be 16 inches long; the pole-angle, for all bipolar types, is chosen at $\phi = 136^\circ$, and the distance between the pole-corners therefore, is $17\frac{1}{2} \times \sin \frac{1}{2} (180^\circ - 136^\circ) = 6\frac{1}{2}$ inches.

Figs. 41 to 50 give the dimensions of various types of frames for the armature, viz., (1) Upright Horseshoe Type; (2) Inverted Horseshoe Type; (3) Horizontal Horseshoe

Type; (4) Single Magnet Type; (5) Vertical Double Magnet Type; (6) Vertical Double Horseshoe Type; (7) Horizontal Double Horseshoe Type; (8) Horizontal Double Magnet Type; (9) Bipolar Iron Clad Type; and (10) Fourpolar Iron Clad Type, respectively.

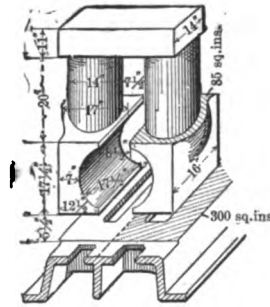


FIG. 41

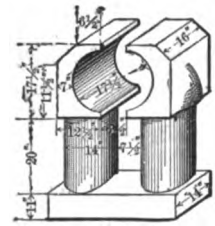


FIG. 42.

The probable leakage factors of these machines figure out as follows:—

1. Upright Horseshoe Type, Fig. 41.

$$\text{By (19): } P_1 = \frac{\frac{1}{4} \left\{ 16\pi + 17\frac{1}{2}\pi \times \frac{186}{180} \right\} \times 16}{1.80 \times (17\frac{1}{2} - 16)} = \frac{875}{1.95} = 192.$$

$$\text{" (32): } P_2 = \frac{14 \times \pi \times 20}{2 \times 7\frac{1}{2} + 1.6 \times 14} = \frac{48.98 \times 20}{15 + 21} = 24.5.$$

$$\text{" (81): } P_3 = \frac{\frac{1}{2} [16 \times (12\frac{1}{2} + 8\frac{3}{4}) + 300]}{2 \times 5\frac{1}{2}} = 29.1.$$

$$\text{" (42): } P_4 = \frac{85}{20} + \frac{16 \times 17\frac{1}{2}}{2 \times 20 + (17\frac{1}{2} + 11) \frac{\pi}{2}} = 4.3 + 3.3 = 7.6.$$

$$\text{" (4): } \lambda = \frac{192 + 24.5 + 29.1 + 7.6}{192} = \frac{253.2}{192} = 1.32.$$

2. Inverted Horseshoe Type, Fig. 42.

$$P_1 = 192.$$

$$P_2 = 24.5.$$

$$\text{By (35): } P_3 = \frac{6\frac{1}{2} \times 16}{6\frac{1}{2} + 6\frac{1}{2} \times \frac{\pi}{2}} + \frac{2 \times 17\frac{1}{2} \times 7}{6\frac{1}{2} + 12\frac{1}{2} \times \frac{\pi}{2}} = 6.2 + 9.4 = 15.6.$$

$$\text{" (45): } P_4 = \frac{85}{20} + \frac{16 \times 11\frac{1}{2}}{20 + (11 + 11\frac{1}{2}) \times \frac{\pi}{4}} = 4.3 + 4.9 = 9.2.$$

$$\text{" (4): } \lambda = \frac{192 + 24.5 + 15.6 + 9.2}{192} = \frac{241.3}{192} = 1.255.$$

3. Horizontal Horseshoe Type, Fig. 43.

$$P_1 = 192.$$

$$P_2 = 24.5.$$

$$\text{By (32): } P_3 = \frac{\frac{1}{2} (14 \times 22 + 300)}{2 \times 5\frac{1}{2}} + \frac{14 \times 22 + 21 \times 18}{6\frac{1}{2} + 9 \times \frac{\pi}{4}} = 27.6 + 25.7 = 53.3.$$

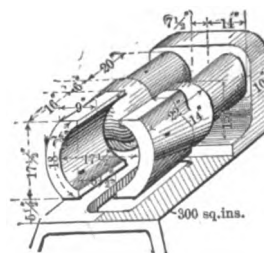


FIG. 43.

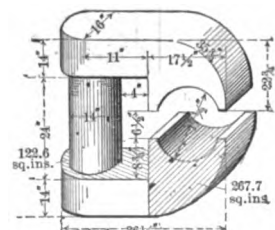


FIG. 44.

$$\text{By (43): } P_4 = \frac{(14 \times 22) + \left\{ 15^\circ \frac{\pi}{4} - 14^\circ \frac{\pi}{4} \right\}}{\frac{1}{2} (20 + 5\frac{1}{2})} = 27.6.$$

$$\lambda = \frac{192 + 24.5 + 53.3 + 27.6}{192} = \frac{297.4}{192} = 1.55.$$

4. *Single Magnet Type, Fig. 44.*

$$P_1 = 192.$$

$$\text{By (36): } P_s = \frac{\left\{ 2 \times 11 + 16 \times \frac{\pi}{2} \right\} \times 14}{24 + 14 \times \frac{\pi}{2}} + \frac{2 \times 267.7 + 16 \times 85\frac{1}{2}}{6\frac{1}{2} + 28\frac{1}{2}}$$

$$+ \frac{122.6}{24} + \frac{16 \times 8\frac{3}{4}}{6\frac{1}{2} + 8\frac{3}{4}} = 14.8 + 38.1 + 5.1 + 9.2 = 61.7.$$

$$\lambda = \frac{192 + 61.7}{192} = \frac{253.7}{192} = 1.32.$$

5. *Vertical Double Magnet Type, Fig. 45.*

$$P_1 = 192.$$

$$\text{By (37): } P_s = 2 \times \left\{ \frac{(49\frac{1}{2} + 16) \times 7 + (228.5 - 78.5)}{16} + \frac{16 \times 4\frac{3}{4}}{6\frac{1}{2} + 4\frac{3}{4}} \right\}$$

$$= 2(38.2 + 6.8) = 90.$$

$$\lambda = \frac{192 + 90}{192} = \frac{282}{192} = 1.47.$$

6. *Vertical Double Horseshoe Type, Fig. 46.*

$$P_1 = 192.$$

$$\text{By (31): } P_s = \frac{14 \times 16}{7\frac{1}{2}} + 2 \times \frac{5\frac{1}{2} \times 16}{7\frac{1}{2} + 5\frac{1}{4} \times \frac{\pi}{2}} = 29.9 + 11.1 = 41.$$

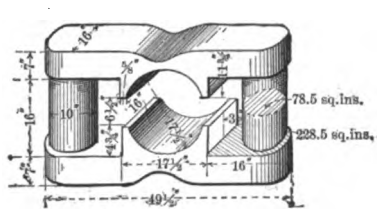


FIG. 45.

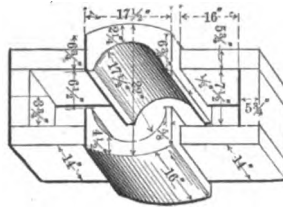


FIG. 46.

$$\text{By (38): } P_s = 2 \times \left\{ \frac{4\frac{1}{2} \times 17\frac{1}{2}}{6\frac{1}{2} + 6\frac{3}{4} \times \frac{\pi}{2}} + \frac{5\frac{1}{2} \times 16}{6\frac{1}{2}} + 6\frac{1}{2} + \frac{1}{2} \times \frac{\pi}{2} \right\}$$

$$= 2 \times (4.6 + 1.6 + 1.1) = 14.6.$$

$$\text{" (44): } P_s = \frac{(16 \times 6\frac{3}{4} - 14 \times 5\frac{1}{2}) + 14 \times 8\frac{3}{4}}{16} + \frac{16 \times 17\frac{1}{2}}{16 + \left\{ \frac{17\frac{1}{2}}{2} + 5\frac{1}{4} \right\} \times \frac{\pi}{4}}$$

$$= 5 + 10.2 = 15.2.$$

$$\lambda = \frac{192 + 41 + 14.6 + 15.2}{192} = \frac{262.8}{192} = 1.37.$$

7. *Horizontal Double Horseshoe Type, Fig. 47.*

$$P_1 = 192.$$

$$\text{By (23): } P_s = \frac{8\frac{3}{4} \times 16}{7\frac{1}{2}} + \frac{6 \times \pi \times 16}{7\frac{1}{2} + \frac{3}{4} \times 6} = 19.3 + 25.7 = 45.$$

$$\text{" (38): } P_s = 2 \times \left\{ \frac{4\frac{1}{2} \times 17\frac{1}{2}}{6\frac{1}{2} + 6\frac{3}{4} \times \frac{\pi}{2}} + \frac{5\frac{1}{2} \times 16}{6\frac{1}{2}} + \frac{1}{4} \times 16 + \frac{1}{4} \times \frac{\pi}{4} \right\}$$

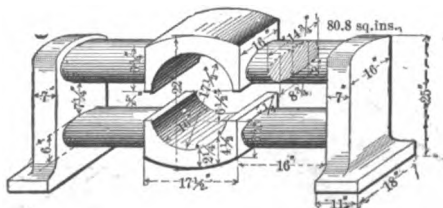


FIG. 47.

$$= 2 \times (4.6 + 1.6 + .6) = 13.6.$$

$$\text{" (44): } P_s = \frac{(16 \times 6\frac{3}{4} - 80.8) + 25 \times 16}{16} + \frac{\left\{ \frac{17\frac{1}{2}}{2} + 7 \right\} \times \frac{1}{2}}{16 + \left\{ \frac{17\frac{1}{2}}{2} + 7 \right\} \times \frac{\pi}{4}}$$

$$+ \frac{\frac{1}{2} \left\{ \frac{17\frac{1}{2}}{2} \times 16 + 11 \times 18 \right\}}{16 + \left\{ \frac{17\frac{1}{2}}{2} + 11 \right\} \times \frac{\pi}{4}} = 14.2 + 4.45 + 6.15 = 24.8.$$

$$\lambda = \frac{192 + 45 + 13.6 + 24.8}{192} = \frac{275.4}{192} = 1.43.$$

8. *Horizontal Double Magnet Type, Fig. 48.*

$$P_1 = 192.$$

$$\text{By (30): } P_s = \frac{16\frac{1}{2} \times 17\frac{1}{2}}{6\frac{1}{2} + 17\frac{1}{2} \times \frac{\pi}{2}} + \frac{1}{2} \times \frac{16 \times 25\frac{3}{4}}{6\frac{1}{2} + 25\frac{3}{4} \times \frac{\pi}{2}} + \frac{1}{2} \times$$

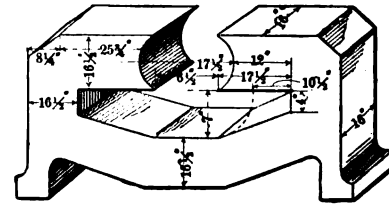


FIG. 48.

$$\left\{ 1 + \frac{10\frac{1}{2}}{17\frac{1}{2}} \right\} \times \frac{16 \times 7}{6\frac{1}{2} + 7 \times \frac{\pi}{2}} + \frac{1}{2} \times \frac{10\frac{1}{2}}{17\frac{1}{2}} \times \frac{16 \times 14}{6\frac{1}{2}}$$

$$= 8.5 + 5.1 + 5.1 + 12.8 = 31.$$

$$\lambda = \frac{192 + 31}{192} = \frac{223}{192} = 1.16.$$

9. *Bipolar Iron Clad Type, Fig. 49.*

$$P_1 = 192.$$

$$\text{By (28): } P_s = \frac{16\frac{1}{2} \times 17\frac{1}{2}}{6\frac{1}{2} + 17\frac{1}{2} \times \frac{\pi}{2}} + \left\{ 1 + \frac{6\frac{3}{4}}{17\frac{1}{2}} \right\} \times \frac{16 \times 5\frac{1}{4}}{6\frac{1}{2} + 5\frac{1}{4} \times \frac{\pi}{2}} +$$

$$\left\{ \frac{6\frac{3}{4}}{17\frac{1}{2}} \right\} \times \frac{16 \times \left\{ 17\frac{1}{2} - \frac{5\frac{1}{4}}{2} \right\}}{\frac{1.285 \times 5\frac{1}{4}}{2}} = 8.5 + 7.9 + 13.6 = 30.$$

$$\lambda = \frac{192 + 80}{192} = \frac{272}{192} = 1.15.$$

10. *Fourpolar Iron Clad Type, Fig. 50.*

$$\text{By (10): } P_1 = \frac{\frac{1}{4} \left\{ 16 \pi + 17\frac{1}{2} \pi \times \frac{58^\circ}{90^\circ} \right\} \times 16}{1.95} = \frac{839}{1.95} = 174.$$

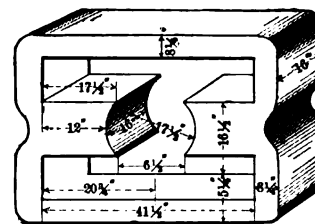


FIG. 49.

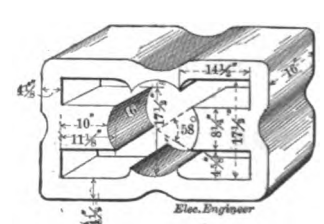


FIG. 50.

$$\text{" (29): } P_s = \frac{16 \times (11\frac{1}{2} + 14\frac{1}{2})}{4\frac{1}{2}} + \frac{8\frac{1}{4} \times (11\frac{1}{2} + 14\frac{1}{2})}{4\frac{1}{2} + 8\frac{1}{4} \times \frac{\pi}{4}}$$

$$= 88.8 + 19 = 107.8.$$

$$\lambda = \frac{174 + 107.8}{174} = \frac{281.8}{174} = 1.62.$$

Taking now the leakage of the bipolar iron clad type, which is the smallest found, as unity, we can express the amounts of the stray fields of the remaining types as multiples of this unity, thus obtaining the following comparative leakages of the types considered:

Upright horseshoe type.....	0.89	+ 0.15	= 2.14
Inverted horseshoe type.....	0.255	+ 0.15	= 1.70
Horizontal horseshoe type.....	0.55	+ 0.15	= 3.67
Single magnet type.....	0.32	+ 0.15	= 2.13
Vertical double magnet type.....	0.47	+ 0.15	= 3.18
Horizontal double horseshoe type....	0.87	+ 0.15	= 2.46
Vertical double horseshoe type.....	0.48	+ 0.15	= 2.87
Horizontal double magnet type.....	0.16	+ 0.15	= 1.07
Bipolar iron clad type.....	0.15	+ 0.15	= 1.
Fourpolar iron clad type.....	0.62	+ 0.15	= 4.14

If, in the latter machine, the stray field of which is somewhat excessive, an armature of larger diameter and smaller axial length would be chosen and the dimensions of the frame altered accordingly, the leakage would be found within the usual limits of the fourpolar iron clad type.

THE MUNICIPAL ELECTRIC LIGHTING PLANT AT PORTSMOUTH, ENGLAND.¹

THE station of the Portsmouth municipal lighting plant is situated in Gun Wharf Road, in a most favorable position both as regards the area of supply and the convenience of obtaining coal and condensing water. Here a large and commodious building has been erected close up to the roadway. There are no pretensions to style about the building. It is of plain red brick, solidity of construction being, perhaps, its most striking characteristic. The station faces a small dock, remarkable as being the only land with a sea frontage owned by the corporation. Through this land pipes are laid which convey sea water to the station for condensing purposes.

On the ground floor of the buildings are arranged a boiler house, engine room, commutating room, coal store, and testing rooms. The floor over the boiler house is divided for offices and mess and committee rooms; these rooms are well furnished and elaborately decorated, perhaps the most noticeable one being the map room, where, in accordance with Board of Trade rules, the walls are carefully papered with a huge map of the district. The object of the map is to show the streets in which mains are laid. The engineer's room is on this floor, from whence the engineer on duty can command an uninterrupted view of the boiler house on the one side and the generating room on the other. The chimney is built on a bed of concrete nearly 20 feet square and 6 feet in thickness, bound together by steel joists. By adopting this method the weight of the chimney is evenly distributed, the pressure transmitted to the shingle which exists beneath the surface not exceeding 1 ton per square foot.

The length of the engine room is 102 feet, the breadth being 66 feet. This is spanned by a fine iron roof. The station is provided with a battery of five steel Lancashire boilers, each 80 feet long and 7 feet 6 inches diameter, with furnace tubes 3 feet in diameter. They have been designed to stand a daily working pressure of 160 lbs. per square inch.

There are two entirely separate ranges of main and branch steam pipes. The boilers are each provided with two standpipes, which terminate in stop valves, each of these being connected with each of the separate ranges running across the boilers. The main ranges have a through valve at the point where they leave the boiler. The steam pipes go to a common centre in the dynamo room, after which they traverse the room one over the other; branch pipes, 5 inches in diameter, connecting each range separately to the engine. A stop valve is provided at the root of each branch pipe where it joins the main; in addition there are two stop valves on the engine. To ensure the steam being freed from water when it reaches the engine, a water separator is inserted in each steam pipe, and at the extreme end of the steam pipe there are water catchers to catch the condensed water. In the construction of the main and branch pipes mild steel plates have been employed. In some cases these plates are one third of an inch in thickness; they are welded longitudinally, and these welds are safeguarded by wrought iron rings, which are shrunk on to the lengths of steam pipe and then riveted. Expansion joints are not employed, the elongation of the main pipes being taken up by legs formed at right angles to the main pipes, these having sufficient elasticity to allow for elongation.

The engines, built by Messrs. Yates & Thom, are two horizontal side by side compound condensing, the fly-wheels, which are utilized as the field magnets of the dynamos, being placed in the middle of the crank shaft between the two cranks. Each engine will give 320 indicated horse-power with a boiler pressure of 160 lbs. per square inch, when running at 96 revolutions per minute.

The high pressure cylinders are 15 inches diameter, and the low pressure cylinders 28 inches diameter, a three feet stroke being given. All the cylinders are steam jacketed in the bodies, lagged with planished steel, and fitted with Corliss valves and gear. The high pressure cylinders are provided with Dobson's patent automatic expansion Corliss valve gear, controlled by the governor of which Messrs. Yates & Thom are the sole makers in England, the low pressure cylinders being provided with Corliss valve gear with variable expansion, which is adjustable by hand when the engines are running; the steam valves in each case are worked independently of the exhaust valves. The piston rods are steel, and of $8\frac{1}{4}$ inches diameter; the crank shaft also, with main journals, is 9 inches diameter and 16 inches long, but is swelled up in the middle to 12 inches diameter. The crank shaft pedestals are cast with the foundation frames, and are fitted with gun-metal steps in four parts, with side wedges and screws for horizontal adjustment. The fly-wheels of both engines are 12 feet 9 inches diameter and $21\frac{1}{4}$ inches wide; they are made in halves, and prepared round the rim for 64 magnet poles. The Ferranti alternator with revolving field is, in short, an integral part of the engine. Each wheel, with bolts, hoops, etc., but exclusive of poles and wiring, weighs about 10 tons. The air pump of each engine is vertical and single-acting, 19 inches diameter and $11\frac{1}{4}$

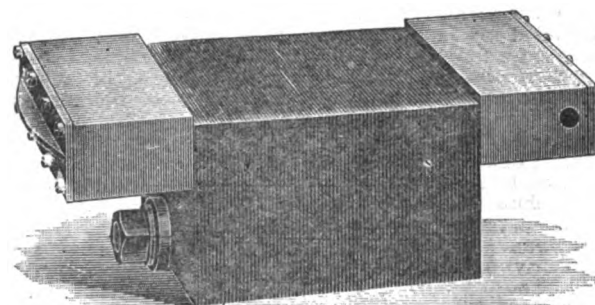
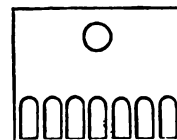
inches stroke, the working barrel being lined with gun-metal and fitted with a gun-metal bucket and rod. The bucket and delivery valves are of India rubber, arranged on the multiple principle. The governor is of the quick-speed type, and fitted with Yates & Thom's improved isochronous motion for maintaining a uniform speed in case of varying steam pressure or varying condition of load on the engine.

Both engines are massively built, and are provided throughout with efficient means of lubrication; brass mounted oil drippers, neatly polished hand-rails and pillars round the working parts of the engines, complete the equipment of these remarkably fine motors. The saving of space with the employment of this class of alternators with rectifiers for public lighting, is enormous.

Each of the Ferranti dynamos gives an output of 212 units at 2,100 volts pressure when running at 96 revolutions per minute. Each machine has 65 magnets, and consequently runs at a periodicity of 50 cycles per second.

The fly-wheel of the engine, as we have already said, has 64 recesses spaced true, radially formed to receive the lower end of the solid wrought-iron magnet forgings, each of which is secured in position by a $1\frac{1}{2}$ inch bolt passing through the rim of the wheel. The wrought-iron magnets are machined all over, having enlarged pole pieces, and are each fitted with a steel steady pin to lock them in position.

The construction of the field magnet coils is novel; it consists of bare copper strip $1\frac{1}{4}$ inch wide by $\frac{1}{8}$ th inch thick wound on its edge, the adjacent layers being separated from one another by paper rings shellaced and pressed into position, the coils being insulated from the magnet core and pole face by heavy fibre washers. The field magnets are all connected



SECTION AND SEGMENT OF ARMATURE.

in series and are put on in pairs, the bottom contacts being brazed together, whilst the top contacts are made by copper angle-lugs. This form of field magnet coil combines good mechanical construction with electrical efficiency, as the edge of the bare copper strip is exposed to the cooling effects of the air, and the winding being only one layer deep, there is thorough heat conduction from the inside to the outside, the proof being that after lengthened runs at full load the copper is scarcely warm, whilst the centrifugal strains are taken on flat surfaces.

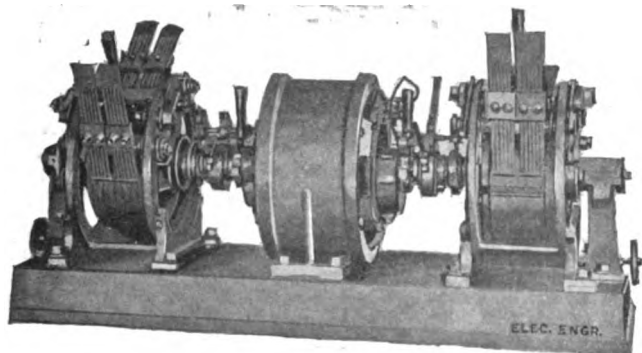
The diameter of the field magnets over all is 14 feet 8 inches, and the exciting current at full load 100 amperes at 80 volts; there is consequently only a difference of potential of about 1 volt between the tops of a pair of adjacent field magnet coils, and, therefore, no fear of short-circuiting due to water, or dirty oil, or other material getting on the magnets while the machine is running, and indeed the construction would permit of the machine being cleaned, if desired, with a hose.

The armature frame which surrounds the outside of the field magnets is supported at both ends by a short massive base plate some 18 inches deep. A segment of the armature is illustrated. The frame is a heavy U-shaped casting in four sections bolted together, and machined on its inside and on the edges. There are 64 armature sections, each composed of a number of laminated Swedish iron stampings; each of these stampings is perforated with seven oblong holes and one circular hole. In the inside of four of these oblong holes mica tubes are fitted, the ends of the tubes projecting some three-quarters of an inch beyond the ends of the stampings. Of the remaining three holes one is left empty, and two are utilized for receiving two insulated manganese

1. Abstract from *The Electrical Review*, of London.

bronze bolts, by means of which the stampings are clamped together and the end boxes secured on. A gun-metal box machined on the top, bottom, and two ends, and having slot holes in the bottom corresponding with the holes in the stampings, is then fitted over the mica tubes; this box contains, in the inside, an ebonite insulator or distance piece, which also closely fits over the ends of the mica tubes, the whole being held in position by the two manganese bronze bolts passing through the laminated stampings.

The armature wire is wound through the mica tubes, the wire being passed through the two middle tubes first until they are filled, and afterwards through the two outer tubes; the ends of



RECTIFIER.

the winding in one box are finished off with a coned copper contact bolt insulated with ebonite, and the ends of the winding in the adjacent box have contact blocks with female cone to fit on to the bolts in the adjacent box. The contact pieces pass from one section to another through the circular holes bored in the ends of the gun metal boxes. The individual sections wound as described are then pressed into the U-shaped armature frames, and are secured in position by an insulated bolt which passes through the flanges of the frames and through the circular hole at the top of the laminated stampings. Connection having been completed between the windings of two adjacent boxes, machined covers are then screwed on, and the whole of the winding of each armature section is thus enclosed in a completely water-tight case, thus preventing the winding being injured in any possible manner.

From this description it will be seen that the whole of the armature is entirely guarded against any accident, the wires being buried beneath the iron. Between no load and full load in this machine there is a variation of 10 per cent. in the exciting current, and the machines run perfectly parallel.

Each dynamo has a series wound exciter, driven by cotton ropes, the driving pulley being fixed on the crank shaft of the engine. The exciters run at 400 revolutions per minute, and according to the requirements of the specification, each gives an output of over 50 per cent. more than is required to excite one alternator.

The current from the dynamo is conveyed by concentric cable constructed by the British Insulated Wire Company, Prescott, to the switchboard, being finished off both at the dynamo and switchboard end in special watertight glands.

The switch gear itself is constructed for controlling five 300-H.P. dynamos, five outside cable circuits, and two arc light circuits, and is complete with all the instruments, bus bar, pilot voltmeters, exciter resistances, etc., occupying a wall space 6 feet wide by 9 feet high, and projecting from the wall some three feet. It stands in the centre of the end wall, nearest the boiler house, and is raised on a wooden platform, thus enabling the operator to have a clear view over the engines, etc.

The concentric system of cables is adopted throughout Portsmouth, with the outer conductors insulated throughout, except at the main switchboard, where the negative bus bar, to which they are joined, is connected to earth.

The inner conductor of the cable passes through a porcelain insulator in the slate division piece, and terminates in a spring fork, which forms one contact for the fuse plug, the other contact being on the underneath side of the dynamo switch, which is immediately overhead. The fuse consists of a stoneware trough, divided in half lengthways. On the outside end of the divisions so formed is a gun-metal plug for making connection with the two fixed spring forks on the switchboard, and in the inside of each recess or trough is a strong spiral spring, which is joined to the contact plug. The fuse itself consists of two rings united by a short length of copper wire; one of these rings is slipped over the end of each spiral spring, the copper wire resting on the top of the central division strip, and causing the spiral springs to be held in tension, and to exert a constant pull upon the fuse. The troughs are filled to within half an inch of the top with an insulating oil, entirely submerging the springs and copper rings of the fuse, leaving the fuse alone exposed to the air.

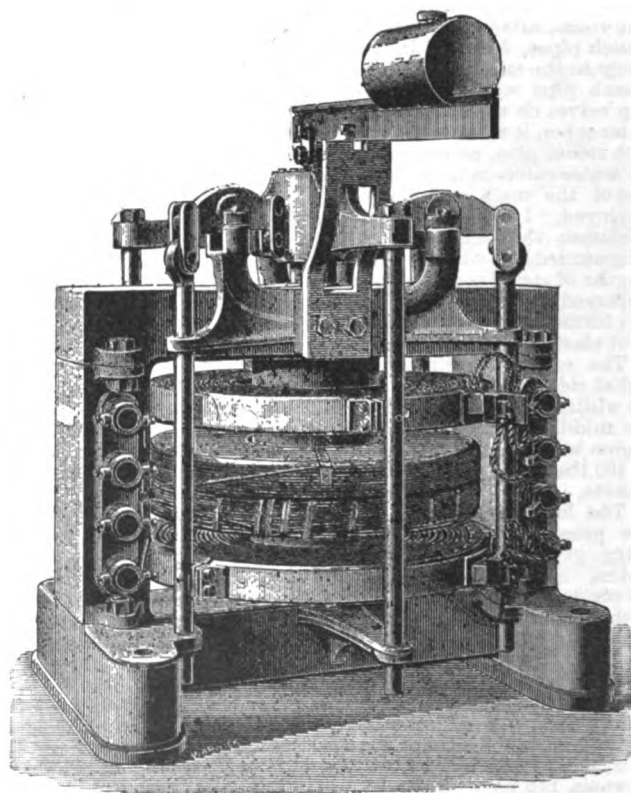
When an excessive current is passed the fuse melts, the two springs come right down into the oil, and the circuit is immediately broken. This fuse acts with great rapidity and breaks the circuit so quietly, that for a moderate current, say up to 50 amperes, anyone standing on the switchboard cannot tell, except by looking at the ammeter, when the fuse goes. At Portsmouth, currents of 120 to 150 amperes, at 2,100 volts, have thus been broken with the utmost ease.

What is of special interest is the fact that the whole of the public lighting is done by rectified currents. Two circuits from the main switchboard are taken direct to the arc light switchboard in the motor commutator room, feeding on the way two converters, one on each circuit, which supply the low tension current for running the synchronous motors of the "motor commutators" or "rectifiers."

The switchboard is arranged for four motor commutators and five circuits; the top is occupied by four three-contact two-way switches, each of which controls one motor commutator, and enables any, or all, of the commutators to be run on either of the two arc light mains. Two of the switch contacts are for the low tension current which runs the motor, and the third for the high tension supply to the constant current arc light converter. Below these switches is a row of five ammeters, pole indicators, high tension reversing switches, and circuit sockets, being one complete set for each of the five arc light circuits. Underneath are four pairs of plugs, with flexible cable attached, allowing the rectified current from any motor commutator to be connected on to any circuit, whilst any circuit can be coupled in series by a pair of independent plugs joined by a flexible cable.

At the extreme bottom are two pairs of instrument plugs and flexible cables, one pair to be used with a Kelvin 8,000-volt electrostatic voltmeter for testing the potential across the arc light mains, or between one main and earth; the other pair of plugs puts a Kelvin ballance in series with a circuit ammeter, to admit of the readings being checked.

The Ferranti motor commutator itself consists of a synchronous, self-starting, alternating current motor, fitted with the necessary commutator for rectifying the current required to excite its own field magnets, and fitted at each end with a special form of commutator for rectifying the current required for the outside arc



TRANSFORMER FOR COMMUTATORS.

lamps. In the case of Portsmouth, each commutator is arranged for rectifying the current for 20 12-ampere lamps, and the two commutators, one at each end of the motor, are connected in series, thus enabling 40 12-ampere lamps to be run in series. A considerably higher E. M. F., say, from 2,400 to 2,500 volts, has been used at Portsmouth, some of the circuits having been coupled in series to make a circuit of from 48 to 50 lamps, in addition to an unusually long length of outside cable; as a matter of fact, as many as 40 lamps, requiring, say, 2,000 volts, have been run off a

single commutator most successfully, so that there is an ample margin of safety.

The commutator consists of two double-winged castings, mounted on opposite ends of a short spindle, on which they are independently fixed and insulated, the wings of the two castings interlapping. When thus mounted, the periphery, sides, and rings are turned in a lathe, and are consequently true with one another. Removable copper segments are then screwed to the periphery, and the clearance space between two wings is partly filled with insulated copper angle strips, whose object is to prevent the fixed collector brushes from jumping when passing from one wing to the next. The commutator is again turned, balanced, mounted in position, and then ground to ensure absolute truth. Each commutator is complete on its own spindle, of which one end forms a female cone, and fits accurately a corresponding male cone turned on the motor shaft.

Surrounding the commutator and concentric with it, is the cast-iron brush-holder frame carrying four sets of brushes, the two double laminated brushes receiving current from the special arc light converter and conveying it to the commutator; the remaining two brushes pick up the commutated or rectified current, whence it flows to the switchboard.

As the two commutators, one on each end of the synchronous motor, are in series, their brush-holder frames are connected together by a cross bar, so that they can be moved simultaneously and rocked round the commutators to secure the best point of commutation, a locking screw fixing them in the desired position.

Each brush-holder has a screw attachment to enable any desired amount of pressure to be put upon the brushes, which can also be kept clear of the commutator when the motor is running light, or as spare.

The periodicity at Portsmouth of the alternator is 50 cycles per second, or 6,000 alternations per minute, and to commute this current the motor commutators have four wings, and run at 1,500 revolutions per minute; for higher periodicities six and eight-winged commutators are employed. The motors are carefully balanced, and lubricated with automatic ring oiling gear, and are stated to run for weeks without requiring any fresh oil.

The success of this system of lighting depends almost entirely on the perfect synchronous running of the motors, so that it is most desirable that the engine driving the main alternator should have a very even turning moment; if this is not done the motors have a tendency to hunt, as they cannot follow the uneven turning of the engine sufficiently rapidly. Any hunting naturally causes a longer spark than necessary at the brushes.

At Portsmouth a very even drive is of course secured by the heavy engine fly-wheel and magnets mounted on it; the surface of the commutator is stone cold after several hours' run, and the tips of the brushes are unburnt and do not wear away at all, and after running for some days the commutator becomes beautifully burnished.

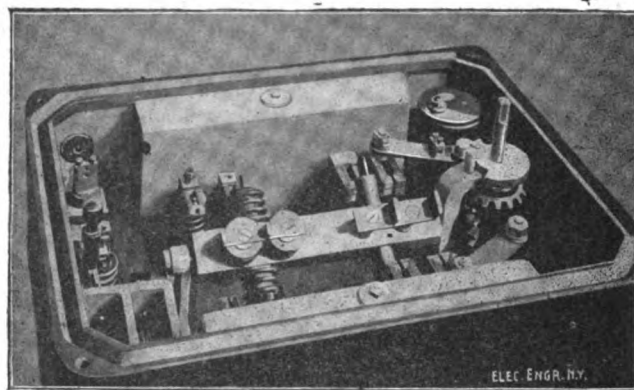
The motor is self starting, the starting switches and the resistances being fixed underneath the table; the small commutator on the motor for rectifying the current required for its own field magnets sparks somewhat until the motor attains synchronous speed, and then it becomes absolutely sparkless.

The whole operation of starting the motor, switching on the lamps, etc., is an extremely simple one, and readily learnt by the ordinary attendants.

For supplying current to the commutators a special converter is employed; this gives a practically fixed or constant current in its secondary circuit, with an E.M.F. varying according to the load on the secondary, and thus is the converse of an ordinary transformer, which gives a fixed E.M.F. and varying current.

The Ferranti constant current converters are constructed to give 12 amperes with 40 lamps in circuit, say 12 amperes at 2,000 volts, and the current only rises to $14\frac{1}{4}$ amperes on a dead short

round the centre of the core, whilst the primary coil above and below them is movable, and is each separately suspended free of the iron core and sides by three brass rods, arranged vertically in the form of a triangle. The three brass rods of one coil are bolted at the top on to a 3-arm star piece, the boss of which is bored out and forms an air cushion with a projecting stem on the converter top; the lower ends of the rods are held in guides which allow them and the star piece to lift vertically. The three rods attached to the other coil are hung by links, fitted with knife edges on to rocking levers. The latter, fitted centrally on knife edges, rock on arms projecting from the converter top casting, and at their inner ends are attached by similar links to the star piece; thus it will be seen that the primary coils balance one another on the



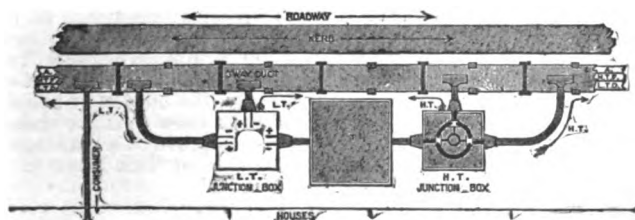
TRANSFORMER OUT OF CIRCUIT.

rocking levers, and move equally towards or away from the fixed secondary coils; the total vertical movement of each primary coil is some 4 inches. The primary coils are so weighted that they just float clear of the secondary coils when 12 amperes passes through the latter; should the secondary current increase, the repulsion becomes greater, and the primaries move away, and so reduce the secondary current by causing more of the lines of force of the primary coil to be diverted. A counterpoise weight, rocking on an arm bolted rigidly to the converter top, permits weight to be added to or taken from the moving coils, and so regulates the current in the secondary to a nicety.

When the engine is running lightly loaded the sudden addition of some 40 horse-power, by switching on an arc lamp circuit suddenly, might tend to pull up the engine and so cause a jump in the lights; consequently a water break-switch is used in the primary of the converter, and so by gradually cutting out the water resistance the load can be put on over two or three minutes, and thus allow the engine to take steam properly.

We must not omit to speak of the Parsons condensing steam turbine alternator, which has been designed for an output of 150 units. This compound steam turbine is arranged for multiple expansion from the 160 lbs. per square inch boiler pressure, down to a condenser pressure of $\frac{1}{2}$ lb. absolute, or a range of about 800-fold expansion. It revolves at a comparatively low speed—3,000 revolutions per minute—and is coupled direct to a two-pole alternator, giving 75 amperes at 2,000 volts, with a periodicity of 50 complete periods per second. It stands on rubber blocks, which rest on a concrete foundation, without any holding down bolts whatever. An automatic variable cut-off valve gear and governor, electrically controlled, maintains a constant E.M.F., and enables the full range of expansion to be maintained at light loads, thus securing exceptional economy of steam on the all-day load. The condenser is of the jet description, but differs somewhat from the usual type. A separate water pump is placed below the condenser, no injection water proper being admitted to the air pump, which is placed above, and is compound. By this arrangement the vacuum obtained is better than is usual with jet condensers, and at the same time the power required to work the pumps is considerably reduced. The pumps are worked from the crossheads of a small tandem compound auxiliary vertical engine, with cylinders 4 inches and 7 inches diameter, and giving a 12-inch stroke, supported on girders, so as to stand on the footplate of the engine room above. The exhaust from this engine can be sent either into the chimney or into the condenser. Valves are arranged so that both the steam turbine alternator and the condenser engine can take their steam from either range of steam pipes, and so that the steam turbine alternator can be run high pressure in case of the injection water failing, or other cause. This turbine is chiefly remarkable as being the largest of its type ever built.

In distribution, the surface of the street pavement is broken in three places for road box covers, viz., for the transformer, high tension junction box, and low tension junction box. The high



PLAN OF UNDERGROUND MAINS.

circuit; thus it will be seen that the accidental extinction of one or more lamps would make no difference to the current passing through the remainder, especially as an adjustable counterpoise weight, fitted on the top of the converter, allows any desired regulation to be made.

The converter consists of a circular laminated iron core, standing vertically, and fitted with a top, bottom, and two end pieces also of laminated iron. Four flat coils surround the core; two are primaries and two are secondaries, the latter being fixed rigidly

tension junction box permits of the current being entirely cut off a transformer, whilst allowing the main to be continuous and to feed other transformers farther on. The low tension box enables the mains to be cut in sections or connected together continuously, and thus facilitates connecting customers or finding faults.

Two types of Ferranti transformers are used, namely, the automatic type and the hand change over type. In the latter the concentric cable passes into a top chamber through a water-tight gland, and the outer conductor is then connected to an insulated terminal; the inner conductor is carried through and terminates on one end of a removable switch, which thus permits the high tension cable to cut off from the rest of the converter; it then passes through an oil-break fuse of similar construction to those employed on the main switchboard, and finally reaches one terminal of the converter.

The converter is wound in two sections, both in its primary and secondary coils, the ends of the sections terminating in eight highly insulated copper rods, carrying at their upper end a modified split ring contact. At times of light load the two primary sections are connected in series, as are also the two secondary sections; but for outputs beyond quarter load the respective sections are connected in parallel.

This is done by means of an ingenious commutator, mounted on two small standards, and occupying the central portion of the chamber. It is actuated by bevel wheels, the upper one carrying a vertical shaft with squared end, which passes through a water-tight gland packing.

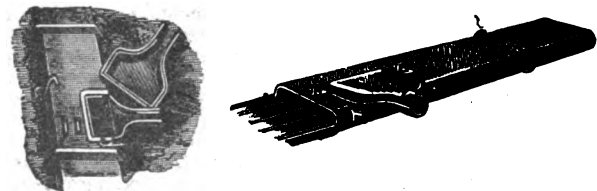
The converters are installed in a brick pit or chamber built under the pavement, and covered with a road box having its covers in halves. A circular hole in one half cover enables a road key, exactly similar to those employed by turncocks, and fitting on to the squared end of the projecting commutator shaft, to be used for turning the commutator from series to parallel, or *vice versa*.

Supposing the converter to take a magnetizing current of 1 per cent. with the coils in parallel, it will only take one-third of 1 per cent. with the coils in series, thus saving two-thirds of 1 per cent. at all times of light load, or a proportionately greater amount if the magnetic current at full load exceeds 1 per cent. Thus the converter would be most economical if the load factor of the station were 25 per cent. These converters can be changed over every day to suit the load requirements, or can be left permanently over in series during the light or summer months. A Cardew safety device is installed in each converter, which are of 15, 20, and 30 kilowatt sizes; consequently comparatively few are required for lighting a town, when the larger sizes are employed.

The body of the converters is immersed in oil, and by a simple arrangement is always under a slight head of oil, to replace leakage, etc. The entire converter and commutator is in a water-tight case.

The automatic converter is the one preferred by the Ferranti Company, and is of the change-over type, brought to the utmost perfection. Here the converter is wound in three sections, in both primary and secondary, which are respectively connected all in series or all in parallel. By this means the magnetizing current is reduced from, say, 1 per cent. at full load to one-fifth per cent. at tenth load, and the converter is most economical on a 10 per cent. station load factor, which is the average factor of most central stations. The change over in this case, however, is done automatically. The low pressure end of the primary coil passes round a relay, which, when the current passing exceeds a given amount, causes a mercury contact to be made, switching on a small alternating motor. This motor is connected by means

being cast upon the edge of the lower and a tongue on the edge of the upper length, so that when put together they exactly fit. These sections are five feet in length, with the exception of the half-lengths, which are used on entering and leading out of the drawing-in boxes, so as to break joints. The groove on the edge is filled with putty, which becomes perfectly hard, and the edge of the top trough, being tongued, fits firmly down upon it. The two troughs are fastened together by means of clamps (which hang on to lugs cast on the troughs) and recessed straps filled with putty, these latter surrounding the abutting ends of the troughs. The clamps and straps are keyed together by means of wrought iron wedges; in this way the conduit forms a solid structure, which will bear the weight of street traffic. The whole of the cast-iron work is coated with Dr. Angus Smith's



CONDUITS SHOWING METHOD OF HOUSE CONNECTION.

preservative solution, which renders it very durable. The section of the conduit which leads into and out of the drawing-in boxes (which are placed about 70 yards apart, and at street corners), are made round instead of square, like the rest of the conduit; in this way a possibility of injuring the insulation of the cable when it is being drawn in is avoided.

In a beautiful room off the engine house the testing arrangements are carried out. The testing set consists of a complete set of instruments by Messrs. Nalder Bros. & Co., mounted on a polished teak table, with the exception of the galvanometer, which is at top on an independent pillar. The instruments are joined up with plug switches, so that by the mere change of a few plugs conductivity, insulation, and potentiometer tests can be made. The instruments consist of a square glazed case galvanometer and shunts, electric lamp and transparent scale, a large size Wheatstone bridge, 100,000 ohm resistance coils subdivided into four coils of 25,000 ohms each, two Carhart-Clark standard cells in one case, reversing key, double contact bridge key, double key with high resistance in circuit for use with standard cells, and various plug connectors and pillar terminals. On trays beneath the table are placed 10 Leclanché cells for use with the bridge, and 90 small dry cells to put in series with them for insulation tests. The electromotive force of these cells can also be taken by comparing them potentiometer-wise against the standard cell.

The ammeters and engine room voltmeters are of Messrs. Nalder Bros. & Co.'s usual alternating type; the voltmeters, however, have large faces 12 inches in diameter.

Those ammeters which are in the machine circuits feeding the bus bars are provided with a new special patented damping arrangement, which effectually checks oscillation, usually so annoying to the station engineer.

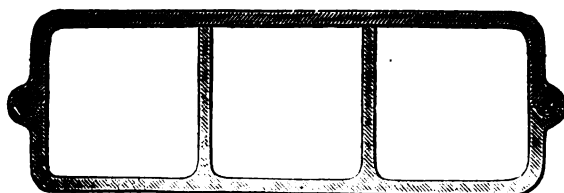
Mr. H. Martin has been resident engineer for the Ferranti firm, during erection, under the supervision of Mr. H. W. Kolle, and Mr. Ferranti himself has lately been at Portsmouth directing the final completion of his work. Mr. Price is the engineer to the Corporation.

MUNICIPAL PLANT LIGHTING FIGURES.

Several comments have appeared in the daily papers on Mr. H. A. Foster's "Municipal Lighting Figures," recently published in THE ELECTRICAL ENGINEER, being an analysis based on returns made with more or less fullness by municipal plants. The New York Evening Post says: "In view of the present condition of our municipal politics throughout the country, the burden of proof is on the advocates of municipal ownership to show that the change from private companies to city control will prove of advantage to the citizens. If we accept the tabulation of THE ELECTRICAL ENGINEER, such a proof cannot be obtained."

The Binghamton, N. Y., Republican says:—

"THE ELECTRICAL ENGINEER publishes statistics collected from all parts of the United States which seem to settle a controversy much discussed generally and locally. It shows the comparative expense of running electric light plants under municipal ownership and under private ownership. Everything considered private ownership has a great advantage in the matter of economy and cheapness. The ENGINEER finds that plants under municipal control are generally unable to impart such information as was called for by the statistician. The presumption is that municipal plants do not usually take into account such matters as capital must consider closely, and that when there appears to be economy in such public works there is likely to be a loss hid away in the lump of figures.



SECTION OF CONDUIT.

of gearing to one end of a strong helical spring, the other end of which gears with the commutator shaft. The motor runs round and winds up the spring strongly; a catch lifts, and the commutator is quickly rotated a quarter of a revolution by the stored energy in the spring, and changes the connections from series to parallel. The contact to the alternating motor is then automatically broken, and cannot again be made until the current in the primary falls to one-tenth load, when the operation is repeated, and the connections changed to series. The action is very pretty, and Messrs. Ferranti claim that with it they can guarantee that over 90 per cent. of the energy generated in the station, can be delivered to the customers.

The conduit in which the mains are laid is a cast-iron structure composed of two troughs, one placed upon the other, a groove

NOTES ON THE EFFECTS OF HIGH FREQUENCY ELECTRICAL DISCHARGES PASSED THROUGH THE BODY.¹

BY ELIHU THOMSON.

The writer has from time to time conducted experiments that prove beyond question the conduction through the body of currents or discharges, the heating effect of which in a carbon filament, whether enclosed in a vacuum or not, is equal to that which is given by continuous currents of from .3 to 1.5 amperes.

There is little or no sensation experienced in such passage provided the surface of contact of the electrode with the skin be not too restricted. It is needless to mention that with ordinary alternating or continuous currents the passage through the arms of so small an amount as 20 to 50 milliamperes may be quite painful.

The apparatus used in my experiments may be described as follows. Ordinary alternating currents of 125 periodicity are passed through the primary coil of a special transformer or induction apparatus, the secondary of which is wound to give currents of about 20,000 volts. The secondary terminals have attachments to the two sides of a large condenser whose capacity may be changed at will. Its construction is such that it resists perforation of its insulating dielectric layers. Each dielectric layer is composed of two sheets of built up mica about $\frac{1}{8}$ inch thick each. Between these double layers the foils are placed and the whole is covered with oil contained in a wooden box or receptacle. This condenser discharges across two air spaces or gaps through which a strong air blast from proper jets is kept blowing. The gaps are formed between two sets of brass balls and arrangements are made to connect to the outer ball of each pair any part of a circuit or path which it is desired that the condenser discharge shall take. A plain coil circle or loop of wire, bare or insulated, may form this discharge path. According to the self-induction of this loop and the capacity used in the condensers will depend the rate or frequency of oscillation of the discharges of the condenser crossing the air gaps. A larger condenser gives a slower rate, as does also a loop or discharge circuit of larger area or self-induction. Hence, it is easy to make the discharges rapid enough to represent rates of 30,000, 50,000, 100,000 oscillations per second, as desired. It must not be supposed that in such an apparatus we can obtain a continuous unbroken set of waves of current like that of an ordinary alternating current, but of high rate. On the contrary, what we do get is a broken set of discharges in which the times occupied by the discharge itself, oscillating while dying out, is small compared to the periods of rest or no discharge.

A brief outline of some of the work may be of interest at this time. The first point to determine was the virtual resistance of the body from hand to hand and to secure, if possible, a passive substitute resistance which could be used instead of the experimenter himself in further tests where needed. Such resistance substitutes were made by taking boxes about two feet long, 1 foot wide, and 6 inches deep, and filling them with sawdust dampened with a weak salt solution. Copper plate electrodes with short heavy cables attached could be inserted into the sawdust at any point in the length of the boxes. Now, placing the body in circuit with an incandescent lamp burning at a given brilliancy it was easy to reproduce the same brilliancy in the lamp by using, instead of the body, the sawdust box and adjusting its electrodes; all other conditions remaining the same in each experiment. A measurement of resistance of the box made at once after the substitution by passing through it a current due to 106 volts and measuring the current which passed, gave a resistance of 750 ohms. A similar substitution of a water resistance gave 650 ohms, so that approximately the virtual resistance of the body of the experimenter could be taken at 700 ohms.

The contact with the palms of the hand was made by metal surfaces tightly grasped and having about 6 square inches contact with the palm and fingers.

By substituting a water rheostat for the body and adjusting it to have the same resistance as indicated by the lamp brilliancy, the increase in temperature of the water during a given time could be made the means for determining approximately the rate of actual heat energy delivery to the body, assuming it to act simply as a resistance, an assumption which so far at least as the conversion of current energy into heat is concerned, is doubtless well founded. It was found that the rate of heat delivery to the water was equivalent to 59 watts or about 2,600 foot pounds per minute.

The significance of this delivery of heat energy is plain. Heat energy may be delivered to the body or a portion of it without exciting the muscles or sensation. Whether this method would for the purpose of the physician have any advantage over the application of warmth externally is not of course yet understood.

On account of the dead spaces and the nature of the discharges in these experiments the maxima of current must be high. It is possible that the greatest wave amplitude may give 10 amperes or more as a maximum.

In some of the experiments, instead of shunting the discharge

loop or coil as described, the arrangement was modified by using a secondary parallel loop or coil the inductive relation of which to the first or primary could be varied. With a single circle of heavy wire the diameter of which was about 3 feet, constituting the primary or condenser discharge loop, a secondary of three turns of heavy okonite covered wire coiled to equal diameter with the primary was sometimes used as the source of high frequency discharges to be applied in the tests. By moving the secondary into more or less exact parallelism with the primary the force of induced secondary currents could be regulated at will. From the terminals of such a secondary connections are made to the electrodes used in conveying the currents into the body.

By bringing the terminals of such secondary to a distance of about $\frac{1}{4}$ inch apart, a torrent of heavy, brilliant sparks accompanied by a very loud roar would be obtained, yet, without altering the conditions such secondary terminals could be bridged by the body, or short-circuited, so to speak, by the hands, with impunity, provided only that the contact surface was not too restricted. It was this coil which when circuited through the arms immersed in salt solution gave a current of heating effect equivalent to 1.5 amperes as above described. The lamp used in this case was rated at 25 volts, 3.5 amperes and was brought to redness by the current passing through it and the body in series. The brilliancy being carefully noted could be reproduced by an ordinary current of 1.5 amperes. So far then the experiments show that it is not any peculiar action or distribution of the currents physically that the comparative harmlessness of high frequency currents is due, but rather that the true cause is physiological; depending on some peculiar relation of nerve excitation to certain stimuli. In other words, nerve matter and muscle seems to be insensitive to such high rates of reversed discharge, and if there be any effects, they are certainly different from those experienced at low frequencies and more different still from the effects of continuous currents.

The normal mental operations and voluntary muscular action were not interfered with to any discoverable extent while the current passed, nor were the involuntary actions affected so far as determined.

PERSONAL.

MR. J. W. AYLSWORTH, experimental chemist in charge of the carbonizing department of the Edison Lamp Works, has tendered his resignation.

MR. MAX OSTERBERG has begun in *Electric Power* a monthly index and abstract of current electrical literature, which promises to be quite complete and very useful.

SOCIETY AND CLUB NOTES.

ELECTRIC CLUB OF CLEVELAND.

At the annual election of officers of the Electric Club of Cleveland, at their club room, on Oct. 3d, the following officers were elected: President, Chas. W. Wason; first vice-president, B. M. Barr; second vice-president, T. E. Adams; secretary, H. J. Davies; treasurer, E. W. Moore. Board of Managers—Chas. W. Wason, H. J. Davies, R. M. Fuller, E. W. Moore, Geo. W. Cleveland.

A TRIP TO RIKER'S ISLAND.

THE New York Electrical Society has arranged for a trip to Riker's Island on Thursday, Oct. 11, to afford its members an opportunity of studying in operation the Woolf system of electrical disinfection of garbage, there carried on so extensively. A steamboat has been provided, and it will leave the pier at the foot of East Thirty-third street, this city, at 2:30 p. m., weather permitting.

BROOKLYN ELECTRICAL SOCIETY.

The above organization of young men actively connected with various electrical enterprises, or else interested in electricity as a study, has proved very successful, both as to membership and as to work. It has now been given the hospitality of the Edison Electric Illuminating Co. of Brooklyn, which has placed a room, power and apparatus at its disposal. Up to the present time, its meetings have been held at the houses of friends and members, and the last of the gatherings under such conditions took place on Thursday last at the residence of the president, Mr. W. Clinton Burling, on Fort Greene Park. The attendance was large, and the Society was addressed by Judge Tenney, Dr. Eccles and Mr. T. C. Martin. After the meeting, refreshments were served and a most enjoyable evening was prolonged till a late hour.

1. Abstract of a paper read before the American Electro-Therapeutical Association, New York, Sept. 25, 26 and 27, 1894.

THE ELECTRICAL ENGINEER.

[INCORPORATED]

PUBLISHED EVERY WEDNESDAY AT
303 Broadway, New York.

Telephone: 1323 Cortlandt. Cable Address: LENGINEER.

Geo. M. Phelps, President. F. R. Colvin, Treas. and Business Manager.

Edited by
T. COMMERFORD MARTIN AND JOSEPH WETZLER.
Associate Editor: GEORGE B. MULDAUR.New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue,
Boston, Mass.Western Editor and Manager, C. KAMMEYER, 1439 Monadnock Building, Chicago,
Ill.New York Representative, 308 Broadway, } W. F. HANES.
Philadelphia Representative, 916 Betz Building, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada	per annum, \$3.00
Four or more Copies, in Clubs (each)	2.50
Great Britain and other Foreign Countries within the Postal Union	5.00
Single Copies,	.10

[Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1888.]

EDITORIAL ANNOUNCEMENTS.

Addresses.—Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of THE ELECTRICAL ENGINEER. Communications for the attention of the editors should be addressed, EDITOR OF THE ELECTRICAL ENGINEER, 303 Broadway, New York City.

VOL. XVIII. NEW YORK, OCTOBER 10, 1894. No. 836.

CONTENTS.

EDITORIALS :—	PAGE.
Latest English Central Station Work.....	294
The Value of an Edison License.....	295
The Trolley Roads in Connecticut.....	295
Municipal Lighting at Toronto.....	295
ARTICLES :—	
A Simple Formula for Magnetic Windings..... F. B. CORRY.	285
Electrical Machinery Practice—IV. (Illustr.)..... J. F. HOBART.	285
Magnetic Leakage in Dynamo-Electric Machinery.—V. (Illustr.)..... A. E. WIENER.	287
The Municipal Lighting Plant at Portsmouth, England (Illustr.).....	289
Notes on the Effect of High Frequency Electrical Discharges Passed Through the Body..... ELIHU THOMSON.	292
Electro-Physiology..... A. E. DOLEBEAR.	296
The Municipal Plant at Alameda, Cal.....	297
The "A. W." Arc Lamp (Illustr.).....	301
NEWS AND NOTES :—	
Municipal Lighting Figures.....	292
Competition for Government Telephone Outfit.....	297
To Utilize Water Power from Los Angeles, Cal.....	299
The Electric Barber.....	299
Electric Power Apparatus for the Washington Navy Yard.....	300
SOCIETY AND CLUB NOTES :—	
Electric Club of Cleveland.....	298
N. Y. Electrical Society—A Trip to Riker's Island.....	298
Brooklyn Electrical Society.....	298
PERSONAL :—	
Mr. J. W. Aylsworth.....	298
Mr. Max Osterberg.....	298
OBITUARY :—	
Mr. W. H. Gordon.....	300
Mr. V. L. Eastland.....	300
Mr. James Crowley.....	300
Dr. Oliver Wendell Holmes.....	300
REPORTS OF COMPANIES :—	
Edison Electric Illuminating Co., New York.....	297
Burton Electric Company.....	297
LITERATURE :—	
Unwin's "On the Development and Transmission of Power from Central Stations".....	298
Heaviside's "Electro-Magnetic Theory".....	299
LETTERS TO THE EDITOR :—	
Armature Core Leakage..... C. P. POOLE.	299
Storage Battery Success and Failure..... W. BRACKEN.	299
Is the Monocyclic System New?..... A. SUBSCRIBER.	300
Not Micanite..... MICA INSULATOR COMPANY.	300
MARRIED.	
Barstow-Du Clos.....	300
INVENTORS' RECORD :—	
Classified Digest of U. S. Electrical Patents Issued October 2, 1894.....	301
TRADE NOTES AND NOVELTIES AND MECHANICAL DEPARTMENT :—	
Carpenter Enamel Rheostat Industry (Illustr.)—Electric Lighting for the League Island Navy Yard.—Discriminating Lightning Arresters.—Western Notes.....	302
"Velvoca" Primary Battery Launch in England.—The Zahn Multipolar Dynamo. (Illustr.)—Chas. E. Gregory Co.—Three Wire Distribution from One Generator.—Electrical Mica.—The Status of the Standard Company.....	303
Ball Engines in the West.—The Anthony Telephone (Illustr.)—Sales of Mather Apparatus.—Philadelphia Notes.—New England Notes.....	304

LATEST ENGLISH CENTRAL STATION WORK.

AS time passes and experience is gained in methods of distribution, old practices give way to more approved ones by which increased economy in operation is obtained. If we seek to trace the causes of these changes we will find that they are due, to some extent of course, to the improvement of the individual pieces of apparatus employed; but the small fraction of increase in efficiency which may have been gained in dynamos, motors, storage batteries, etc., during the last few years is not sufficient to account for the difference in the central station economy attained to-day in many cases, compared with that of ten years ago. We must therefore look farther, and a closer study will show that our present improved practice is not due so much to the apparatus itself as to the manner in which it is handled. It is more particularly the full recognition of the conditions of working as indicated by the station load line that has brought about the modifications in practice now observable. The former discussions of high tension *vs.* low tension, and continuous *vs.* alternating system have not entirely died out, it is true, but they have given place to discussions in which the question of steam economy and station units are given the most prominent place. We are led to these reflections in viewing the important municipal plant recently installed at Portsmouth, England, by Mr. Ferranti, to a description of which we devote considerable space in this issue. The station is well worthy of close study and is an excellent example of a thoroughly worked out plan to enable an alternating station to operate with economy under all conditions. It may be looked upon as an answer to the advocates of the continuous current system and their contentions that the inherent properties of the alternating system leave it at a disadvantage at light loads, as compared with its rival. Within the station itself the light day load is carried by a 150 H. P. Parsons steam turbine driving a 2-pole (!) alternator. This is the largest Parsons engine thus far built, and as these engines have been shown to take less than 15 lbs. of steam per horse power hour, their employment for this work seems eminently calculated to bring about the light load economy aimed at. But it is not within the station alone that provision has been made for this purpose. The old, and, we are bound to confess, valid argument, of the continuous current partisans,—that even with the best system within the station, the transformers are inefficient at light loads,—is here answered by the application of a method, the outcome of which in practice will be watched with considerable interest. The adjustment of the converter to adapt it to light loads, making its point of maximum economy at 10 per cent. of full load, is a most radical departure, but one which we do not by any means consider unwarranted by experience. The method of changing over converters from light to heavy load by means of a handswitch, savors, it is true, considerably of the old perambulating lamplighter, but the automatic switch devised for this purpose removes even this objection.

There is still another important departure in the operation of the Portsmouth station, the exact *raison d'être* of which, however, is not clear. We refer to the rectified

current employed for arc lighting, obtained by means of motor-commutators. The large number of arc lamps connected to low tension constant potential alternating circuits, now working successfully, leave us in doubt as to the object had in view by Mr. Ferranti. If it was the desire to have a system by which all the city arc lamps might be under direct control of the central station,—which of course is hardly possible with the lamps in multiple on consumers' circuit—then the Stanley high tension series alternating arc system brought out some time ago would appear to fill the requirements. This would have permitted the utilization of the station current without modification except as to that needed for regulation to obtain constant current strength. Again, the high degree of perfection to which alternating arc lamps have now attained makes it hardly probable that the continuous current arc lamp should have been selected in preference to the former on grounds of merit. Leaving this question aside, however, the fact that a part of the station output is converted into continuous current is in itself significant and suggests the possibility of further extension of the method for the distribution of continuous current for motor power purposes. To just what current limits motor commutators can be successfully employed is still a matter to be determined by experience, but the rotary transformer affords the electrical engineer a device with no limit as to current strength or potential, and with an efficiency and ease of operation which would make its employment advantageous in many situations. We cannot help admiring the thoroughness with which the details of the Portsmouth station have been worked out and we sincerely hope that the results obtained in practice will bear out the hopes of its talented designer.

THE VALUE OF AN EDISON LICENSE.

As the incident may now perhaps be regarded as closed, there will be no impropriety in referring to the crisis that arose during August last in the relations between the Edison licensee companies and the parent General Electric Co. The convention in Boston brought to a head the discontent and dissatisfaction that had been entertained so long as to the treatment received at headquarters, by local companies, and the feeling on the subject was apparent even to those who were permitted by courtesy to cool their heels outside the barred convention doors. We may mention now that as a matter of fact, the Association went so far, under the excitement of its grievances, as to hold out the threat of starting its own company to build Edison apparatus and supplies, if it did not obtain justice. The National Electric Light Association once suggested pretty much the same thing, but did not show quite the same pluck.

Anyhow, the General Electric Co. was confronted by an actively hostile spirit on the part of the Association, including some who not long before had been its own officials; and it soon made wisely the concessions to force which it was less ready to make to justice and equity. Mr. W. S. Andrews to-day, if we are rightly informed, sits as referee in all such matters at Schenectady, and it is his business to see that Edison local companies get their rights as to bottom prices and quick dispatch of orders. In some quarters, this pacification is viewed with a regret that we can hardly share. It is not a good thing that parent and local companies should be at daggers drawn all the time or that capital already invited into the field should be jeopardized by unnecessary squabbles and revolutions. As we are not credited with passionate attach-

ment to the General Co. we may venture freely and heartily to congratulate it on having found a way to retain the friendship and good will of those who rank among its largest customers, and to hope that the peace established may endure.

THE TROLLEY ROADS IN CONNECTICUT.

We commented recently on the competition for traffic in Connecticut between the new trolley roads and the Consolidated Railroad. The situation appears to have grown tenser lately. According to the *Ansonia Sentinel*, the two trains known as the "High Rock Special," which have run between Naugatuck and Waterbury all winter heretofore, have been withdrawn already. The *Lawrence American* says that the trolley competition has made a difference of \$300 per week, and quotes a well-known railroad man as saying: "Why, since the trolley line has been in operation the railroad people have not made enough with their High Rock special to pay for the oil used by the locomotive." The *Sentinel* thinks, wisely, that for long travel the trolley cars won't do for people who want to travel quickly; but then it should not forget that there is a vast bulk of people who can afford to travel slowly; and after all fifteen miles an hour is not so very slow. We believe sincerely that these long trolley roads are going to catch an enormous amount of travel in which the time element cuts no figure as against the convenience of frequency and the money economy of one cent or a half a cent per mile. Moreover, we note in the *Boston Herald* a statement that on the Northampton division of the Consolidated a train between Northampton and Williamsburg has been ordered to discontinue because the trolley has impaired its earning capacity. Hence it is not one branch that is affected, but more than one, and when a steam railroad finds its income clipped here and there, its general efficiency is going to suffer. That this should happen all would deplore, but it is getting to be high time for some of the steam roads to decide what they are going to do about it.

MUNICIPAL LIGHTING AT TORONTO.

An interesting little episode has occurred in the municipal lighting field, in the recent award at Toronto, of the contract for city lighting to the old company. During many months past, Toronto has been discussing the desirability of a municipal plant and has obtained elaborate figures as to the cost of apparatus. In the meantime the Toronto Electric Light Company had put in new bids, being determined of course to hold the business if there were any reasonable possibility of doing so. The issue has now been reached and the Toronto Electric Light Co. will continue to do the city lighting. It was found that at the lowest figures a city plant would cost \$253,007. Allowing interest at 4 per cent. and depreciation at 6, the annual charges would be \$25,300. The cost of maintenance would be \$75,295. For 1,300 street lights, this would mean a cost to the city for light per year of \$77.37. The bid of the local company is, however, only \$72.82½ per light per annum, and the city council could therefore hardly justify itself in spending public money on work which private parties were ready and willing to do more cheaply. We cannot say that the city authorities present themselves in a very favorable light, and we can well understand the indignation of some of the bidders for the new plant, who find that the only use made of their long work and painstaking figures is that of a club against the existing contractors.

ELECTRO-PHYSIOLOGY.¹

BY PROF. A. E. DOLBEAR.

I believe that it is conceded among physicians who have studied the physiological effects of electricity that the immediate effects are altogether physical and chemical.

Assuming this to be true one may inquire what are the physical and chemical effects of electricity, in order that he may look for them in physiological processes.

First. A current of electricity always heats the conductor through which it goes, and this quite independent of how much work of other sorts may be done in the same circuit. Whether it be turning a motor or lighting an arc or incandescent lamp or decomposing a chemical compound or any other, these simply cut down the current in their circuit, and the heating power is proportional to the square of the current. So one may conclude that when an electrical current is sent through any part of the body, that part is more or less heated. With such currents as are employed in everything except perhaps in electrocution, the heating effect is so small as to be well nigh ignorable. A current of one ampere in a resistance of one ohm will raise the temperature of a pound of water only one hundredth of a degree in a second, but the resistance of the body is to be reckoned by thousands of ohms and the currents employed in thousandths of an ampere. A current of 10 m. a. or the hundredth of an ampere through one ohm would heat it only one ten-thousandth of one hundredth or the millionth of a degree in a second, or, to state it in another way, would require nearly two weeks to heat a pound of water one degree.

Second. A current will produce light, as is evidenced in the arc and incandescent lamps, but the light is the effect of the higher temperature, for it is the carbon raised to incandescence which is the cause of the light and as the heating effects are so minute no luminous results due to incandescence can be expected in physiological applications. There is another kind of luminousness observed in rarefied gases when alternating currents of high voltage are sent through them, but they are not observable in solids and liquids and there is no evidence that there is any corresponding physiological effect.

Third. A current may bring about chemical decomposition.

A typical case of this is the decomposition of water. Whenever a current can enter the body it enters it through its fluid conductors, chiefly water; dried tissues of all sorts being non-conductors.

Fourth. An electric current will make a magnet, or rather it is a magnet itself. The magnetic field, whatever its source, reacts in some degree upon all kinds of matter within it. There have been many attempts to discover this field by sensation. Lord Kelvin tried it years ago and expressed some surprise that there did not appear to be a magnetic sense. Peterson and Kennelly have more recently tried it with exceedingly strong fields and they have concluded that "the human organism is in no wise appreciably affected by the most powerful magnets known to science."

As to such conclusions I would suggest that the explanation of the failures to perceive any effects might be attributable to two causes; 1st, a magnetic field acts upon *molecules*, not upon physiological organs as such. There is no tendency to twist, warp or strain a muscle as such, and hence sensory nerves for muscular movement would have nothing to report. 2nd, A constant stress of light value does not give rise to sensation for ordinary mechanical causes. Lay the arm carelessly and without looking at it, on the table where it can be comfortable, and, for a short time turn the attention to other matters. Then without looking at the arm or moving it in any way see if you can tell how the fingers are crooked or which ones touch the surface of the table. Not until some muscles be moved can one tell what shape his hand is in and yet it has been subject to constant pressure all the time. For this reason then, that a constant pressure producing no movement ought not to be expected to give a perception I am not surprised at the results reached. 3rd, A magnetic field whether constant or varied has no chemical effect. It does not bring about atomic changes. Such changes require energy of a different sort, and any nerves whose function it was to respond to chemical changes would not find anything to report from a magnetic field.

As for the brain itself which has been exposed to the strongest available magnetic field, for considerable lengths of time with no results noted, I would ask why one should expect sensory results from an organ which is itself not sensitive? Cannot the brain itself be dipped out with a spoon without sensation? Sensation implies nerves, and particular sensations particular nerves, and there are no substitutions neither the white nor the gray matter possessing nerve cells. If the brain were affected by a magnetic field, I should expect it would need to be detected by other means than by the direct sensation. I therefore conclude that the experiments alluded to, prove that magnetic effects do not produce the mechanical and chemical changes necessary for sensation, rather than that they are absolutely without any effect. This latter conclusion if adopted would at once demand the acceptance of the proposition that electrical effects are not the same within

the body as they are without and that would necessitate in physiology the revival of a vital force or something like it.

Fifth. An electric current in a given conductor induces another electric current in an adjacent conductor. Hence it is possible to set up electric currents in any conducting body without having any electrical conductor between it and a primary source of electricity. This is the principle employed in telegraphing without wires between two points. Whether such a method has any physiological importance I do not know, but I should think it might sometimes where currents of particular frequencies or character are desirable and not so easily to be had with an electromagnetic breaker as in the ordinary induction coil. In another way it has some theoretic interest. It has been reported that anesthesia may be brought about by subjecting a part of the body, a finger for instance, to an alternating magnetic field. This, observe, is not sensation but the absence of it; there is nothing in the reports of the experiments with magnetic fields to show that tests of sensitivity were tried, they were probably not tried in any.

Now, I believe it has been demonstrated that alternating electrical currents at some unsettled but very high rate of alternations can for the time being destroy sensation so that, say, a tooth may be pulled without pain. If there be nerves of sensation in an alternating magnetic field, and they be made a part of an electric circuit as they very well may be made, then changes of magnetic polarity may bring about *current* changes in the organism and these may have any of the results that belong to currents, and if currents under any conditions will produce insensibility, then the effects between magnetic poles will be due, not to the magnetism itself, but to the currents of electricity which the magnetism induces.

I have heard it objected to the view that magnetic fields could produce any physiological effects, that, if so, those who work with alternating currents of electricity and especially such as are near dynamos and motors would have noticed it, yet none have ever reported it. If, however, the real effect was one to lessen their sensitivity in general, one would hardly expect one to know anything about what had happened without comparisons. Experiments need to be made for all the nerves. Can one see or hear or taste or smell or touch as acutely in such a varying magnetic field or with alternating currents as he can without them?

If there is anything at all in this anesthesia by currents without bringing on tetanus, I should suppose it would have a wonderful field. For instance, in sea sickness there could be found a current of some degree and frequency that would be quite insensible to the feelings, which would prevent at once the nervous condition, and an electrical device could be worn continuously on ship-board without discommoding one. The chief difficulty, I should suppose, would be to find the proper route for the provided current. If, for instance, the immediate cause of sea sickness be, as I have somewhere read, the movements of the fluid in the semi-circular canals, then electrodes might need to be fixed in the ears.

Then again, it is now well known that electric currents are generated in the body by the contraction of muscles as well as by chemical action, wherever these may take place. These currents are exceedingly weak, too weak to be able to do any of the wonderful things that are alleged to be due to them by so-called "magnetic" healers. It requires the most delicate apparatus we have to detect them at all, nevertheless an electric current always has direction and a conducting circuit. The query is, which are the conductors in the body? The nerves have often been compared to conductors and some have thought that the impulses in them called "nervous transmission" were electric currents; on the other hand the measures of the rate of impulse have been found to be so low,—less than a hundred feet a second—that some have concluded that such nervous current could not possibly be electrical, inasmuch as the velocity of electricity is reckoned to be so great. This has never seemed to me to be conclusive. The old experiments on the velocity of electricity did not measure that at all. They at best indicated the rate of flow of a certain amount of electrical energy, which is a different problem. If a conductor be a poor one it may take a good while to get enough electricity through it to produce any observable result, and that I think, is the case with the electric conductivity of a nerve. Aside from the nerves, there are the blood vessels filled with good conducting materials, muscular tissue of various kinds not so good, and fatty tissue almost non-conducting, so that what will be the route of an electric current between two points in the body, may not be the same in different persons. I should expect that a given current would be much the densest in a lean or muscular person and much scattered by adipose tissue, even a large surface electrode of a square foot which will carry a current of 23 milliamperes without injury to the surface itself might, on account of slight conductivity of the underlying tissues, and be made destructively dense in some portion of its course. I cannot give an example, but think it probable.

And last but not least, what may be said of electricity as a curative agent! If one cannot give a technically correct description of electricity itself, yet this we do know, that an electric current is the bearer of energy in such a form as to be readily avail-

1. Abstract of a paper before the American Electro-Therapeutic Association.

able for mechanical, chemical or magnetic effects, and which of these will be the result depends altogether upon what kind of mechanism is provided for it. Inherently, electricity has neither curative nor destructive qualities. I do not think there is any evidence that it attacks life or that in any sense it is life, as some have thought. One might as well say that heat is life or chemism is life. Electricity has directly to do with molecules and atoms. It can shake molecules apart and permit new molecular arrangements. If these new products chance to be useful or harmful to the organism it will be benefited or injured. The particular advantage, which is a very great one, is, these products may be produced where they are wanted. This is now practically applied in electrolytic and catalytic adaptations. Its electrotonic action may be due more to the electrolytic products at nerve terminals than to their direct excitation. Considering a nerve as a conductor, its quality does not depend upon its conductivity but its conductivity depends upon its quality. Is it not quite as probable that if for any reason nerve action is judged to be slothful it is due to the fact there is nothing to conduct, that is, the metabolic changes at the nerve terminals are not rapid enough, as that the trouble is due to the nerve itself. This of course supposes the nerve to be intact.

I cannot forbear to allude to a matter of high theoretic interest directly related to electro therapeutics. Since it has been practically demonstrated that what we call light is a set of ether waves of electro-magnetic origin, it has been apparent to some, though others have not seen the significance of the work that we are compelled to postulate, that all atoms are magnets seeing that all can and do give electro magnetic waves. There was a good deal of reason for thinking so before. This new evidence seems to compel one to assume it. Hence on this assumption it follows that the living body is but a combination of an enormous number of atomic magnets. I use the word atomic advisedly, for molecules are but combinations of atoms and their properties are only the resultant properties of the atoms that make them up. Every movement of every molecule and atom in the body is, then, a magnetic movement in magnetic fields and must induce magnetic and electric changes all about it. It was long ago shown by Faraday that electrical and chemical changes were quantitatively related. Now it is seen that electro-magnetism underlies all chemical action. The significance of it here lies in the fact that in working with electricity to effect physiological changes one is really at work with the fundamental factor in physiological energy, not in a round-a-bout, but in the most direct way.

Functions of all sorts are electromagnetic in the last analysis, and he who understands these and the art of properly applying electro-magnetic energy to languishing or diseased organs will be able to do all for humanity that skill can do. The more I study the relation of life to the things upon which it depends, the more I am persuaded that though death may be for the benefit of the race, it is not necessary for the individual.

THE MUNICIPAL PLANT AT ALAMEDA, CAL.

WE have received from Mr. W. M. Goldthwaite, the city electrician of Alameda, Cal., a very interesting communication in regard to our recent analysis of municipal electric lighting plants in this country, which include statistics from his department. Mr. Goldthwaite in the course of his letter says:

"We should have been particular to inform you of all we are doing outside of simply lighting the streets, which should appear to our credit. To explain: During eight months of the year (the dry season in this country) we furnish the Street Department \$7.50 worth of water daily for sprinkling at a cost to us of \$3.50 per day. All labor and tools furnished in the care of the city's fire alarm system of 12 miles of wire; 22 oxes, 5 engine houses, fully equipped with strikers, gongs, automatic gas lighting, 140 battery jars, etc., is charged to electric lighting account. The same is true with reference to police telephone stations, nine in number with 6 miles of wire. The city also maintains an electric signal service between the City Treasurer's office, two banks, and the office of the Chief of Police, all in my care. My salary strictly belongs in the list of city officers, but the clerk has it as electric light expense. I have at one time and another called the attention of the city council to these facts and asked that they instruct the clerk to segregate these various expenses from what is rightfully chargeable to electric light account that I might appear in a proper light when making known to enquirers the cost of our lighting. We ought to be credited as follows:

Pumping water for street-sprinkling, fuel and repairs..	\$4.50
Labor and tools, and care of team, for F. A. service...	900
" " care of Police Tel. service.....	300
Sundry supplies.....	50

Total for one year..... \$1,700

"Thus you will notice that we have saved the street and other departments more than \$3,000, at an expense to the electrical light department of \$1,700. The authorities, however, are not particular about opening separate accounts as they know the

saving to the municipality as a whole by combining these departments under one management is as represented, and they do not realize how it affects me. The clerk's report for last year was \$11,106.85; corrected it will be \$9,406.85.

"Personally I do not care for any explanation you might make in your journal at this late day, but I have letters from friends who are desirous of having the "erroneous" statements corrected. This plant, which was a tumble-down affair when I took charge over eight years ago, has now reached its turning point. It has been largely improved from time to time (all included in operating expenses) until now everything is first class but dynamos and lamps. As an item of news I send you some clippings of reports on the proceedings at last meeting of council."

Mr. Goldthwaite furnishes us with items from which it appears that the city council has accepted a bid of the Westinghouse Electric and Manufacturing Co. for a new arc plant for \$4,863, and \$3,796 for an incandescent plant. Alameda is a city of 15,000 inhabitants, and needs the enlarged plant, which will probably be started in about 60 days.

COMPETITION FOR GOVERNMENT TELEPHONE OUTFIT.

Bids for the construction of a telephone exchange system for the Department of the Interior were opened at the Department, Washington, on September 24, 1894.

The following is a list of the bids admitted:

Royce & Marean, Washington, D. C., one 12-drop switch board, for grounded circuits, \$50; one 120-drop switch board for grounded circuits, \$375. Wiring, cable box, cable, labor, and all materials for completing system, excepting switch boards and instruments, but including connecting the same, \$1,195. One hundred and twelve complete telephone desk sets, and three operators' sets, \$2,500. Total amount, \$3,920.

As a supplemental bid they propose to replace the present outside wiring with galvanized iron wire for \$200. Iron wire in excess of or below estimate, \$12 per thousand feet. Whole work to be completed within 75 days after execution of contract therefor.

The Southern-Harrison Telephone Co., Washington, D. C., 112 complete telephone desk sets, and 3 operators' sets, \$3,500. Time 90 days.

Gerson Electric Co., Philadelphia, Pa., informal, 112 complete telephone desk sets, and 3 operators' sets, \$1,165.

Chesapeake & Potomac Telephone Co., Washington, D. C., one 120-drop metallic circuit switch board, \$150, or \$3,989.60 for everything called for in specifications. Time 3 months.

The Department, for some unexpected reason, has decided now to ask for new bids on new specifications.

JUST THE MAN.

We shall make no charge for putting any employer in communication with the accomplished writer of the application below. Clearly he is the sort of man to have around an electrical concern in either busy or dull times.

Mess. _____ N. J.

Gentlemen:

N. Y. C.

Experienced salesman, stenographer, electrician, rigger, pianist, used to handling men, herewith applies for position with your house. Trusting you've room for a hustler, and will appoint interview, I am
Respectfully,

REPORTS OF COMPANIES.

EDISON ELECTRIC ILLUMINATING CO., NEW YORK.

The following comparative statement of earnings is issued by The Edison Electric Illuminating Co., of New York:

	1894.	1893.	
Gross.....	\$91,955.96	\$74,559.24	\$17,396.72 Inc.
Net.....	38,985.37	24,874.78	14,110.59 Inc.
EIGHT MONTHS.			
Gross.....	\$366,353.64	\$765,288.73	\$101,069.92
Net.....	454,337.87	340,674.93	113,662.94

BURTON ELECTRIC COMPANY.

The annual meeting of the stockholders of the Burton Electric Company was held recently at Richmond, Va. The following officers were elected for the ensuing year: President, W. J. Johnson; directors, Edward Jewell, Arthur B. Smith, Ambros Eastman and Levi L. Parsons, all of Boston, Mass., and W. J. Johnson, of Richmond. The secretary reported that he was rapidly exchanging the certificates of the Burton Company for those of the American Electric Heating Corporation, in accordance with the orders of the stockholders issued in July.

LITERATURE.

On the Development and Transmission of Power from Central Stations. By William Cawthorne Unwin, F. R. S., London; 1894. Longmans, Green & Co. 308 pp., 6 x 9 inches. Price, \$3.50.

THIS is a work of some 300 pages treating, as its title implies, of the several methods of developing and transmitting power. The following extracts from the first chapter will indicate the scope of the work:

"Energy is in these lectures to be considered as a commodity, which can be manufactured in a convenient form, and distributed and sold. The special problems to be dealt with are, the conditions which favor the production of a convenient form of energy on a large scale and in the most economical way; the means of conveying it to a distance and distributing it to consumers; the arrangements for measuring the quantity delivered; and lastly, the relative advantages and disadvantages of a system in which energy is obtained on a large scale and distributed to many consumers, compared with a system in which each consumer produces the power he requires in his own locality and under his own supervision and responsibility."

"That the author has more knowledge of some of the older and more mechanical methods of power distribution than of the newer methods of electrical distribution may be considered a disadvantage. But the distribution of electricity both for lighting and power purposes has already been fully discussed, both in special treatises and especially in the lectures of Prof. George Forbes and Mr. Gisbert Kapp. On the other hand, there may be some partly compensating advantage in approaching the subject for once with the bias of an engineer rather than that of an electrician."

From this last quotation we should expect to find much the larger portion of the work given to the discussion of the "older and more mechanical methods, of power distribution," and to the electrical engineer this is by no means a disadvantage. As the author says, electrical methods of distribution have been fully discussed in special treatises. To these the electrical engineer has access, while it has not been easy to find the data, and discussion of the results of experience with the older methods of distribution necessary to enable one to make an intelligent comparison.

More than one third of the work is devoted to the study of the sources and development of mechanical energy. Data are given showing the comparative values of the various fields and the evaporation efficiencies of the various types of boilers. The working of steam engines is discussed at length and numerous results of tests given. One chapter is devoted to the cost of steam-power. In this the author, estimating the cost of an effective horse power per year under the conditions obtaining in an electric lighting station, at £19.25, about \$96,—gives as the best result reported to the Board of Trade from an electric lighting station at Bradford £49, about \$245, per effective H. P. per year! The writer has considered our American record susceptible to great improvement, but it is good compared to the above.

In the chapters on water power and water motors, brief descriptions of some of the large water power installations in the United States are given, but very few cost data are included, and indeed such data would be of little use since the cost of any particular plant depends very largely upon local conditions. In the chapter on motors no mention is made of the Pelton wheel and no reference is made to the use of the high mountain waterfalls of the Rocky Mountain mining regions. Brief reference is made to the use of water pressure engines under high pressures, but no data are given. Half a dozen pages are given to a discussion of the action of turbines, but the electrical engineer who is proposing to convert water power into electrical energy will, on this point, find little assistance from this book.

The study of transmission of power begins with rope transmission in Chapter VII. Descriptions at some length are given of various installations, but when we look for data as to first cost, cost of maintenance, efficiency, etc., we meet with disappointment. They "involve considerable cost." "Experience has also shown that the cost of maintenance is considerable." "The efficiency of transmission to such distances as those of Schaffhausen" (some 2,000 feet) "is undoubtedly very great." The author intimates that for distances of a mile rope transmission would compare favorably with electric transmission, but he gives the reader only such vague statements as those quoted above as a basis of comparison.

Chapter VIII on hydraulic transmission is more satisfactory. Data relating to loss by friction in mains, to the cost of the water delivered, to the power that may be delivered through mains of different sizes, are given, as well as descriptions of various installations.

On pages 160-162 the author describes "a very remarkable scheme of hydraulic distribution of power" at Antwerp. The system was devised by Professor Van Rysselbergh who, recognizing "the inconvenience of the distribution of electricity from a single station over a wide area" adopted hydraulic transmission

as the primary means of distribution. The pressure used is 770 lbs. per square inch, and the motors are used directly for industrial purposes or to "drive dynamos producing electricity in electric substations scattered at convenient positions over the district," and serving as secondary systems of distribution. From the author's data, a 6-inch pipe, new and clean, with 750 lbs. initial pressure, will transmit 100 H. P. with a loss of about 5 per cent. per mile.

At a pressure of 1,000 volts a No. 000 wire will transmit the same power with the same loss. Such a conductor, of bare copper, would cost only about \$600 per mile, while a 6-inch pipe capable of standing 750 lbs. pressure, with the necessary bolts and flanges could cost not less than \$5,000 per mile. Even if the electric conductors were laid under ground it does not appear that the hydraulic system could have such a great advantage in cost with an initial electric pressure of only 1,000 volts.

But the best part of the work is that devoted to "Transmission by Compressed Air." This comprises about eighty pages. In addition to the data and the description of installations given, considerable space is devoted to the theory of the operation of air compressors and motors. The advantages of cooling the air during compression and of reheating at the motor are discussed, and also the advantages of compound compressors and motors. In consequence of the small amount of friction of air conveyed in pipes, comparatively high velocities may be employed, and considerable power may be transmitted. The author claims that while a 6-inch pipe at 750 lbs. pressure will only transmit 90 horse power by the use of water, the same pipe at 45 lbs. pressure will transmit 150 horse power by compressed air.

In Chapter X is discussed the theory of transmission by compressed air taking into account the subsidiary losses. The author computes the efficiency of transmission for two assumed cases first for the transmission of 10,000 H. P. two miles, and second, for 10,000 H. P., 20 miles. The 10,000 H. P. is the indicated power of the steam engines driving the compressors. Upon certain data, partly derived from experiment, and partly assumed, he arrives at the result that at two miles 4,500 brake H. P. may be delivered from the motor if the air is used cold, and 6,500 brake H. P. if the air is reheated; or the efficiency of the whole system is 45 per cent. if the air is used cold and 65 per cent. if the air is reheated, but in the latter case the author neglects to take account of the energy imparted to the air in reheating. At 20 miles the air used cold gives about 4,000 brake H. P., and reheated, about 6,000 brake H. P. at the motor, and this without materially increasing the size of the pipe for the longer distance.

It is to be regretted that the author does not give actual results derived from existing plants and also that he does not take up the financial problem and compute the cost of the power delivered in the two cases given.

In Chapter XIII on "Electrical Transmission" the author discusses the question of the most economical size of conductors and deduces a series of results which are arranged in tabular form. The computation is based upon Lord Kelvin's law, but the author entirely ignores the fact that Kelvin's law applies only to the case where the fixed quantities are, the pressure and the energy to be delivered, at the receiving end. That law does not at all apply to the case where only a given amount of power at a given pressure are available at the generating station.

For instance, Table III, page 275, gives the "Economical section of one conductor in sq. in.," for pressures at the generator from 100 to 10,000 volts and power at generator of from 100 to 10,000 H. P. Three cases are given for different costs of power at the generating station. Under Case I we find for 100 H. P. at 100 volts at the generating station, that the most economical section is .386 sq. in. This, by Kelvin's law, is the same, regardless of distance. At the bottom of the same page is given the loss of pressure in the line in volts per mile. For Case I this is 127 volts. In other words, if we have at the generating station 100 H. P. at 100 volts, and we wish to use the power at a distance of one mile over a conductor of the "economical section," given by Kelvin's law, we should not only consume the entire available energy on the line, but we should have to supply some energy at the other end in order to send the energy from the generator over the line at all! The writer can see no economy in using a conductor that consumes all the available energy and more. The value of the results on pages 270 to 278 is greatly impaired in consequence of the assumption upon which they are based.

But it was not to be expected that the electrical engineer would find much that was new or useful to him in his own department. It is in the other departments, where the author's interest chiefly lies, and where the electrical engineer's knowledge is generally most deficient, that the value of the work will be found. Electrical engineers have generally paid too little attention to those methods of transmission, especially to that by compressed air, which, in the writer's view, is the only real competition of electric transmission. Compressed air certainly has advantages for some installations and the engineer who has a problem in transmission to solve should approach it as an engineer in the broadest sense, and recommend that system which is best adapted to the special conditions.

W. A. ANTHONY.

Electro-Magnetic Theory. By Oliver Heaviside. Vol. I. Electrician Printing and Publishing Company, Ltd. London, 1893. 466 pp. $8\frac{1}{2} \times 5\frac{1}{2}$ inches. Price, \$5.

This book has been written with the object of elucidating the theory of electro-magnetism from the standpoint of the foundation laid by Clerk Maxwell. The first twenty pages are introductory; the next hundred pages are devoted to an outline of electro-magnetic relations; the next ninety pages to the development of vectorial algebra in relation to electro-magnetics, and the remainder of the book is devoted to the theory of plane electro-magnetic waves.

Practically all that is given in the first three hundred pages has been previously published by Mr. Heaviside in his other writings, although not in so consecutive a form. Of course, the ready accessibility of all the steps in one publication is an advantage for this book. The chapter on plane electro-magnetic waves has, however, received a treatment, which is in a large measure new, and the subject has evidently reached a more complete development in the author's mind than upon the occasion of any previous paper that he has devoted to it. It is, perhaps, not too much to say that the author has a clearer grasp and insight into electro-magnetic theory than any living writer. Where he writes in the language of symbols, which has become second nature to him, his ideas find clear, terse, and adequate expression; but where he endeavors to express the same idea in the unsymbolic language of the vernacular, they suffer severely in terseness, accuracy and lucidity. The book has evidently been written with an endeavor to make clear to the student of more elementary mathematics, the truths and relations of electro-magnetic science, but it is easy to see that where the language is confined to symbolic treatment, the masterly power of the author displays itself to advantage, while the paragraphs of verbal descriptive matter often descend to vapidity rather than to explanation. Mr. Heaviside is not a man who possesses the capability of expressing quantitative ideas in simple language, but perhaps it is too much to ask any man to possess not only a genius for expression in symbols, a capability for continued quantitative research, the power of generalization from the results gained in that research, and in addition to all this a gift for expressing ideas in a manner that can be readily comprehended by the exoteric.

Certain conclusions are, if not drawn, at least indicated in this book. Two of them may be stated as follows:

(1) That magnetism is a phenomenon of motion and not a static phenomenon; also that this motion is more likely to be translational than vortical.

(2) That all electric currents are phenomena consequent upon the emission of electro-magnetic wave disturbances in the ether, and that the proper treatment of all the phenomena of currents and magnetic flux should be considered as the consequence, and not as the cause, of electro-magnetic waves.

The ultimate results of the book are two-fold.

(1) The first ultimate result is purely mathematical, which is important only to those who study mathematical physics. There can be very little doubt that the system of vectorial algebra as developed by Mr. Heaviside in these pages is far superior for physical investigations to the methods of quaternions. Whether this system is destined to be adopted, or whether it will have to undergo still further developments before it receives practical acceptance by mathematicians, is a question which can scarcely be answered at present.

(2) The second ultimate result is physical. It consists in more closely uniting the more recondite problems of telegraphy, telephony, Teslaic and Hertzian phenomena with the fundamental properties of the ether. In elucidating this connection, the merit of the book appears most prominently as a stepping-stone to the goal in the full view of all physical analysis, namely, the resolution of all physical phenomena to the activities of the ether, and of matter in the ether, under the laws of dynamics. H. & K.

TO UTILIZE WATER POWER NEAR LOS ANGELES, CAL.

The Electric Power Co. has been incorporated at Los Angeles, and the directors are E. C. Seymour, P. Kehl and W. E. Van Slyke of San Bernardino, and M. L. Graff and H. W. Latham of Los Angeles. The company is capitalized at \$1,000,000, and its intention is to develop electrically a large water power in the mountains about 80 miles to the northward of the city. This power will give steadily about 3,000 h. p., it is said, and the expectation is to sell it at \$36 per h. p. per year, yielding a net return of 11 per cent. on the full investment. It is stated that the promoters of this enterprise have already begun to ditch, buy machinery and carry out preliminary work.

[THE ELECTRIC BARBER.

An ingenious citizen of Tacoma has devised an apparatus in which the principle of the electric fan is utilized to blow a current of warm air through the locks of a customer who has been having his head shampooed.

LETTERS TO THE EDITOR.

ARMATURE CORE LEAKAGE.

It is with much regret and compunction that I note, from Mr. Wiener's remarks in your issue of Sept. 13 the great surprise he experienced by reason of my criticising his statement as to armature core leakage before finishing his very able and interesting article.

I had no desire to startle Mr. Wiener in the security of his calculations or to seem unduly hasty or ungenerous in my criticism, and while I appreciate his article and the pains he has been at in preparing it, I am compelled to continue in the firm conviction that Mr. Wiener has gone astray in the matter of armature core leakage, no matter how many careful deductions from practical machines he may have made, or what further argument he may bring forward to his support.

It is a well-established fact that the electromotive force generated in any armature is represented by the expression

$$\frac{N \cdot C \cdot S}{b} 10^{-9}$$

where N is the total number of useful lines emanating from all the poles of like sign, C the number of armature conductors all around the periphery, S the number of revolutions per second, and b the number of bifurcations in the armature, or the number of brush points of like sign on the commutator.

It is just as positive a fact that none of the armature conductors can pass a magnet pole without cutting every line of force proceeding from that pole to the armature core, excepting the negligible number of lines which leak around on the outside from tooth to tooth, and therefore practically all the lines passing from pole face to armature core are useful lines.

Mr. Wiener's argument that at any given instant of time there will be lines of force passing into the armature teeth without cutting any armature conductors is a very deceptive and misleading one, and has no bearing upon the total number of lines cut by any conductor during a complete revolution of the armature. It would be as reasonable to say that those conductors which lie upon that portion of the armature not covered by the pole pieces cannot be taken into account in figuring the output of the armature, because at any given instant of time there will be conductors occupying this position and cutting no lines of force whatever. Supposing that the pole pieces covered 60 per cent. of the armature surface and the magnetic fringe affected 15 per cent. additional, then there would be 25 per cent. of the armature conductors which would, at any given instant of time, be entirely idle as to the generation of E. M. F.

In figuring the output of such a machine Mr. Wiener, to make good his argument, would have to give C , in the expression above cited, a value of only 75 per cent. of its actual value; does he suppose that such a calculation would pan out?

Taking another case a little nearer that in point, suppose one so constructed a machine that the teeth on the armature-core had ample capacity to pass all the flux furnished by the field magnet without becoming saturated. Then at any given instant of time every bit of the flux passing from the polar faces (of course outside leakages are not taken into consideration), to the armature-core would pass through the teeth without cutting any of the armature conductors, and, according to Mr. Wiener's argument, the armature would generate no E. M. F.; or, giving him the benefit of what leakage there might be between teeth, the output of the armature would at the most be practically insignificant.

If Mr. Wiener will try this experiment he will probably be more surprised by the result than he was by my former criticism, and his theory of core leakage will receive a distressing shock.

CECIL P. POOLE.

LYNCHBURG, VA. Sept. 13, 1894.

STORAGE BATTERY SUCCESSES AND FAILURES.

ON page 269 of your valuable issue of the 3d inst., you print a paper by James K. Pumpelly, entitled, "Chips from a Storage Battery Workshop," in which he goes on to show what a calamitous failure the Faure-Brush pasted type of plate is, and what a unique success the Pumpelly storage plate is. In other words, the Tudor Company, in Germany; the Electrical Power Storage Company, in England; the Accumulator Company; the Consolidated Electric Storage Company, the Bradbury-Stone Electric Storage Company, and a number of other companies, all of whom manufacture the Faure-Brush type of plate and who monopolize the storage battery business of the world, are wasting their time and imposing on their customers, when they might, I have no doubt, obtain from Mr. Pumpelly a license to manufacture the only battery that is worth a cent. It is true that he admits he was equally confident of possessing a great battery, two years ago, which he now frankly says "developed some weaknesses." He tells us it got weak in the "joints," and so he had it sent to his famous

"hospital," where, lo! a brand-new plate "evolved from experience," he says, in the aforesaid hospital, promises to realize the hopes of the most sanguine storage battery maker.

Now there is not one new feature about this plate. It is a structure which has been long since abandoned by competent scientists experienced in the art. It is a Planté plate; a lead frame filled with bars separated from one another by narrow interstices (vide U. S. patent No. 487,884, W. W. Griscom, dated Dec. 18, 1892); it is subjected to an electro-chemical process (old and described in numberless patents); then subjected to the usual electrolytic formation (which Mr. Pumpelly mysteriously calls "another process"); finally the plates are assembled in the usual way—the only difference between this and the old style Planté plate is that Mr. Pumpelly's plate will disintegrate more quickly and have a shorter life. The "lead laminæ" produced by the chemical process (rotting process), are of more injury than benefit. This process, theoretically attractive and begotten of the ardent desire to hasten formation, has long since been pronounced worthless by competent makers. The honeycomb so produced is far different from the disintegration produced by oxygen evolved in the usual way; it is destruction, not conversion. This type of plate has been tried over and over again, only to be discarded.

W. BRACKEN.

NEW YORK CITY, Oct. 5, 1894.

IS THE "MONOCYCLIC" SYSTEM NEW?

HAVING studied the article entitled "Operation of Induction Motors on General Electric Company's Monocyclic System" appearing in the September 26th number of your valuable paper, I write for some further information regarding the system. Wherein does the fundamental principle of the system differ from the so-called Tesla system which you have described in former issues?

It would seem that the circuits of the "Monocyclic" system are the same as those of the Tesla two-phase system, with the addition of another load upon one branch of the system; and that, although the motors may operate as synchronous motors when running at certain speeds and with certain definite balancing of loads, they must necessarily, through the greater part of their operations, operate with what Tesla has termed "progressively shifting fields."

Any information you can give through your columns upon this subject will be appreciated by the writer and I think will also be useful in enlightening prospective investors who naturally might be deterred from purchasing apparatus which may be supposed to be an infringement of the Tesla system. A SUBSCRIBER.

NEW YORK CITY, Oct. 5, 1894.

(In order fully and satisfactorily to answer our correspondent would necessitate a somewhat extended discussion and comparison of the two systems referred to and would necessarily include matters involving patent rights. Under these circumstances it seems hardly within our province to give our correspondent the opinion or information he seeks; but we have no doubt he will be able to have his curiosity satisfied by applying to those immediately interested in the systems in question. We would venture to suggest, however, that the study of the book on "The Inventions, Researches and Writings of Nikola Tesla," particularly the complete section on his work with phase currents, may answer the question, or at least aid in a clearer understanding of the subject. —EDS. E. E.)

NOT MICANITE.

In your issue of October 3 we note an article on "Electrical Machinist Practice," by James F. Hobart. He states: "Very little mica is used in commutators for railroad work. In its stead, a made-up product, called micanite, is used. This material is built up of small waste pieces of mica, cemented with shellac."

We wish you would make the correction in the next issue that Micanite is not made of small waste pieces of mica. We use the regular sheet mica in the manufacture of Micanite, and do not use any waste mica.

MICA INSULATOR COMPANY.

NEW YORK, Oct. 6, 1894.

MARRIED.

BARSTOW-DU CLOS.

MR. WILLIAM S. BARSTOW of Brooklyn and Miss Françoise M. Du Clos, daughter of J. W. Du Clos of Highland Park, a suburb of New Brunswick, N. J., were married on September 4. The groom is the general superintendent of the Edison Electric Illuminating Company of Brooklyn. Conspicuous among the presents was a silver service valued at \$1,000 from the directors of the Edison Company. Mr. and Mrs. Barstow will live in Brooklyn after taking an extended tour. The bride is the sister of Mrs. C. L. Edgar, whose husband is general superintendent of the Edison Company of Boston.

OBITUARY.

MR. W. H. GORDON.

A great many members of the electrical community will regret to learn the news of the death at Bergen Point, of Mr. W. H. Gordon, of this city, after an illness of 17 weeks. The deceased was at one time actively engaged on the Chicago Board of Trade, and then becoming interested in electricity removed to New York, where he became a representative of the Electrical Supply Co. Later he became an agent for the Simplex wires and cables, and carried on business as W. H. Gordon & Co., dealing in electrical supplies of all kind. Some months ago he succumbed to painful internal disease, and for months may be said to have been making a struggle for life. Mr. Gordon was widely known, and was well liked both for his cheeriness and for his untiring energy. He leaves a wife and a family of young children. He was 43 years of age. The interment took place last week at Cincinnati, after the funeral exercises at Bergen Point.

MR. V. L. EASTLAND.

WE regret to announce the death at Oakland, Cal., of Mr. Van Leer Eastland, Superintendent and General Manager of the Oakland Gas, Light and Heat Co. Mr. Eastland was born in the city of Nashville in 1835 and was therefore 59 years of age at the time of his death which was due to heart trouble.

He had been identified with the gas interests on the Pacific Coast since 1854. In 1867 he took charge of the Oakland Gas Light Company in the position of Superintendent and General Manager and maintained that relation with the Company up to the time of his death, a period of 27 years. The works with which he was connected grew under his management from a plant having a daily capacity of 5,000 feet of output to one having a capacity of three-quarters of a million, while connected with it and adding to his arduous duties was an electric light station having a capacity of 1,100 horse-power. His associates speak most highly of his worth and ability.

MR. JAMES CROWLEY.

James Crowley, ex-Superintendent of the New York Police Telegraphs died in this city on Oct. 6. He retired from his office in November, 1892, when he was in point of service the senior member of the force. Mr. Crowley was appointed to the old Municipal Police some time previous to 1853. He was made Superintendent on Sept. 12, 1860. He distinguished himself during the draft riots, and when, on July 18, 1863, a mob at Third avenue and Forty-sixth street tore down the telegraph wires, Superintendent Crowley, seized the bundle of wires on the downtown side of the cut and coiled them around a lamp post, grounding them, and establishing communication between the Central Police office and the more important stations up town. Mr. Crowley was the inventor of the police patrol indicator used in this city.

OLIVER WENDELL HOLMES.

THE death of Dr. Holmes, which occurred at Boston on Oct. 7, has already been recorded in the newspapers, with copious sketches of his career and literary work. There is no need now to recapitulate facts so well known, but it is proper to record here the deep interest taken by Dr. Holmes in all electrical work. His famous poem on the laying of the first Atlantic cable, and his even more amusing poem on "The Broomstick Train," were but evidences of his partiality for electrical themes. During late years he has kept in touch with the newest thought, and not long ago wrote to one of his correspondents that he had been reading the Tesla lectures with great pleasure.

ELECTRIC POWER APPARATUS FOR THE WASHINGTON NAVY YARD.

Bids were opened at the Navy Department on October 2, 1894, for furnishing the Washington Navy Yard with one electric traveling crane having a lifting capacity of 25 tons (2,240 pounds), each; one electric traveling crane having a lifting capacity of 10 tons (2,240 pounds) each. The following is a list of the bids submitted: Yale & Towne Manufacturing Co., \$11,584. Morgan Engineering Co., \$9,572. Manning, Maxwell & Moore, \$10,985. The Industrial Works, \$20,300. Bids were also opened for furnishing the Washington Navy Yard with supports and run-ways for two electric cranes—one of 25 tons capacity, and one of 10 tons capacity; to be built and erected in place in the gun-carriage shop; estimated weight of structure, 228,000 pounds. The following is a list of the bidders: Morgan Engineering Co., \$8,745. S. C. Forstath Machine Co., \$9,514.44.

THE "A. W." ARC LAMP.

The great desirability of having an arc lamp which allows the intervals between trimming to be extended beyond that possible with the present style of lamps in use needs no demonstration. If, in addition, the character of the lamp is such as to fulfill all the other requirements of a good arc lamp, it must of necessity

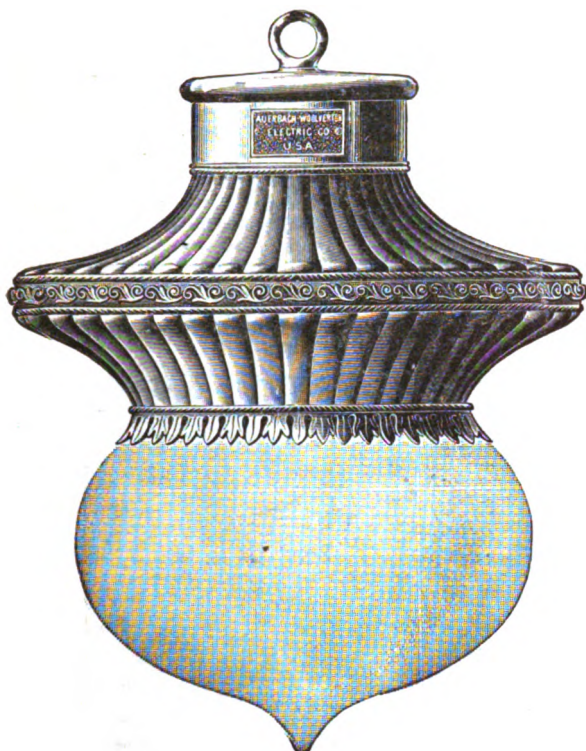


FIG. 1.—"A. W." ARC LAMP.

make itself felt as a valuable addition to our present arc-lighting apparatus.

An arc lamp, which, it is claimed, embodies the qualities just mentioned, is that brought out by the Auerbach-Woolverton Electric Co., of the Cable Building, No. 611-621 Broadway, New York.

Our engraving, Fig. 1, shows the high tension series lamp in perspective and Fig. 2 shows its simple mechanism. In order to obtain long burning capacity, two sets of carbons are burned simultaneously, to give but a single arc. This is effected by having a pair of carbons each for the positive and for the negative. Each pair of carbons is mounted so as to slide along rods, and they are so inclined that they meet at their ends at one point. When the current is turned on, the magnet in circuit, acting through its core, separates the pair of positives from the pair of negatives and springs the arc,—and then its function, so far as regulation is concerned, ceases entirely.

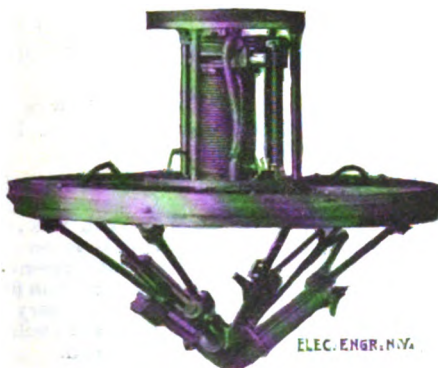


FIG. 2.—"A. W." ARC LAMP.

The regulation is effected by the carbons themselves. These are so mounted that, as their tips are consumed by the arc, they slide towards each other by their own weight, and no rack, clutch, or mechanism of any sort is required to perform this action, gravity alone acting to accomplish the result.

As the carbons are always fed toward a fixed point, it follows that the arc must also remain fixed at the point where the carbons meet, and at the same time the arc is maintained steady, and free from shifting. With the ordinary $\frac{1}{2}$ inch positive carbons the

lamp burns for 25 hours, without retrimming. Its construction also presents several advantages. Thus the entire lamp is only 18 inches high from top to bottom, including the globe, so that it is particularly adapted for indoor lighting in rooms with low ceilings. Again, the lamp throws no shadows, and all the light is thrown downward, where it is wanted.

The "A. W." lamp has been adapted for low tension, high tension and alternating circuits.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS
ISSUED OCTOBER 2, 1894.

Alarms and Signals:—

Electric Alarm Operating Mechanism, P. C. Thompson, Elmira, N. Y., 536,760. Filed Dec. 19, 1893.

A device for sounding an electric alarm and automatically interrupting it after the lapse of a suitable length of time.

Conductors, Conducts and Insulators:—Composition of Matter for Electric Conductors, D. Macfarlane, Philadelphia, Pa., 536,721. Filed May 16, 1894.

Consists of asbestos or mineral wool, graphite and a binder.

Composition of Matter for Electric Conductors, D. Macfarlane, Philadelphia, Pa., 536,722. Filed May 16, 1894.

Consists of graphite, clay, asphalt or coal tar, chloride of aluminum and a binder.

Dynamoes and Motors:—

Electric Motor, J. H. Clark, Boston, Mass., 536,686. Filed Apr. 16, 1894.

The invention relates to a compact form of motor adapted to the driving of ventilating fans.

Commutator, H. G. Reist, Schenectady, N. Y., 536,742. Filed June 28, 1894.

Relates especially to means for securing in place the segments of the large and heavy commutators of the direct coupled dynamo.

Dynamo Electric Machine, E. W. Rice, Jr., Swampscott, Mass., 536,743. Filed Feb. 23, 1894.

Employs means for causing the entire magnetic flux to pass coincidentally through the axes of the coils during part of their revolution.

Apparatus for Putting Electric Motors into Circuit, C. Hoffman, Charlottenburg, Germany, 536,810. Filed Oct. 29, 1893.

A method of regulation consisting in automatically and simultaneously varying the resistance of the circuit in inverse proportion to the counter e. m. f. of the motor.

Dynamo Regulator, J. Van Vleck, New York, N. Y., 536,879. Filed May 31, 1894.

Relates to the construction and arrangement of that class of regulators which operate by throwing into the circuit more or less resistance at will.

Lamps and Apparatuses:—

Electric Lamp Hanger, W. S. Weston, Chicago, Ill., 536,825. Filed Jan. 13, 1894.

Miscellaneous:—

Electric Winding and Setting Clock, H. Loriot, New York, N. Y., 536,790. Filed Oct. 3, 1893.

Electric Lighting Apparatus for Fire Engines, W. C. Matthias and W. Hartman, Reading, Pa., 536,723. Filed Oct. 2, 1893.

Electric Belt, J. J. Hankey, Beaver Dam, Wis., 536,893. Filed July 18, 1894.

Railways and Appliances:—

Trolley Wire Hanger, J. J. Green, Boonton, N. J., 536,704. Filed June 4, 1894.

Employs supporting devices consisting of parts struck from sheet metal and formed so as to be adapted to conjointly engage the trolley wire supports.

Trolley Spring, J. L. Hanson, United States Army, 536,703. Filed May 14, 1893.

Claim 1 follows:—

The trolley spring made up of two similar clasp springs having their spiral bends interlocked, and the ends of their members oppositely connected.

Trolley Guard, H. J. Tanner, Lynn, Mass., 536,758. Filed April 2, 1894.

Employs two spring actuated rollers on either side of and partly above the trolley wire adapted to retain the wheel in position.

Electric Railway Conduit, R. B. Wilson, Cincinnati, Ohio, 536,767. Filed Jan. 2, 1894.

A conduit having a projecting base and each section having a socket at one end and a corresponding portion at the opposite end forming a continuous conduit when the sections are placed together.

Conduit Railway Trolley, R. J. Hewett, St. Louis, Mo., 536,835. Filed Feb. 9, 1894.

Claim 1 follows:—

A conduit collector provided with an adjustable steering device engaging the slot walls at a point in advance of the plow to automatically adjust the collector to curves.

Conductor Switch, G. H. Benjamin, New York, N. Y., 536,850. Filed Sept. 28, 1893.

Employs working conductors for the main and also for the switch track, one of the tracks having sectional conductors normally in a different plane from that of the main conductors, and means for bringing the former into the plane of the latter to complete the circuit.

Switches and Out-lets:—

Electric Snap Switch, A. Metzger, Schenectady, N. Y., 536,735. Filed May 11, 1894.

Has for its object to prevent injury to the switch in case the handle is in the wrong direction.

Lightning Arrester, F. S. Pearson, Boston, Mass., 536,736. Filed Sept. 7, 1891.

Claim 2 follows:—

In combination a lightning arrester, a switch, its detent, an electro-magnet, a fuse, a main circuit, and a branch circuit with two branches, one branch containing the arrester, and the electro-magnet series, and the other the fuse.

Rheostat, D. Macfarlane, Philadelphia, Pa., 536,867. Filed May 18, 1894.

Consists of an insulated homogeneous composition structure having pin contacts over which a switch is adapted to move.

Telephones and Apparatus:—

Telephone, H. W. Libbey, Boston, Mass., 536,865. Filed Aug. 1, 1892.

Claim 1 follows:—

In a telephone, an armature arranged between the poles of a horse shoe magnet, and the diaphragm, said armature being suspended by cat gut or silk cord.

Transmitter for Telephones, M. O. Anthony, Cincinnati, O., 536,888. Filed July 23, 1894.

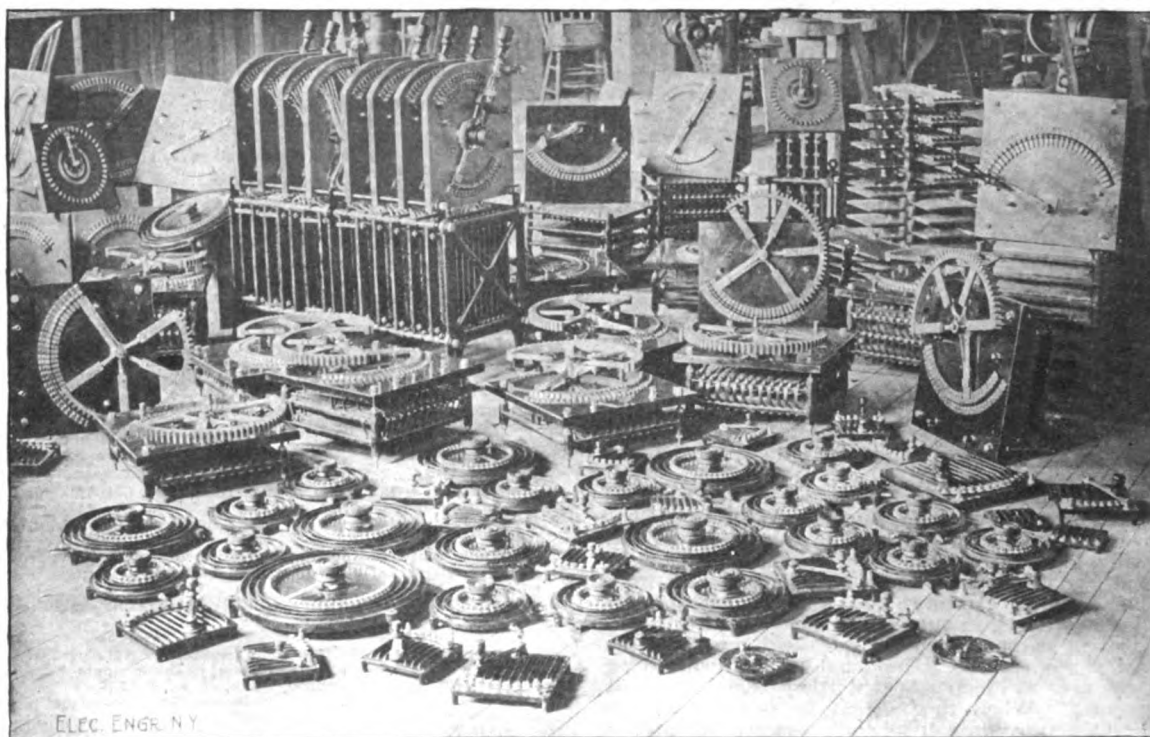
Employs a series of carbon blocks projecting from a supporting plate, carbon pencils extending between the blocks, and transverse pencils connecting one or more pairs in the series and locking them against rotation.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE CARPENTER ENAMEL RHEOSTAT INDUSTRY.

To some of our readers, who have not kept close watch of the development of the Carpenter enamel rheostat industry, the accompanying picture will come in the nature of a surprise. The engraving shows a group of the various kinds now being made at the new factory in Hoboken, and is taken direct from a photograph. The range of size and type is not more striking, however, than the variety of applications, and to all these features taken in common must be attributed the Carpenter Co.'s remarkable exemption from the dullness that has prevailed in the electrical trade so long, and which even now is slow to dissipate. When the Carpenter Co. moved its works from Bridgeport to Hoboken last June it secured what it thought would be ample space for the requirements for some time to come, but the increase in its business has been so rapid that it has become necessary for the company to provide twice as much additional space as it is already



GROUP OF CARPENTER ENAMEL RHEOSTATS AT THE HOBOKEN FACTORY.

occupying. The company is now moving into the newly acquired area, and with the commodious annex thus obtained hopes at least to keep up with orders for the present and in the near future.

ELECTRIC LIGHTING FOR THE LEAGUE ISLAND NAVY YARD.

Bids have been opened at the Navy Department for the installation of an electric light plant at the League Island Navy Yard, Philadelphia. The following is a list of the bidders:

Westinghouse Electric Manufacturing Co., Pittsburgh, Pa., \$11,816. International Trading & Electric Co., New York, N. Y., \$9,787. Crescent Electric & Manufacturing Co., Brooklyn, N. Y., \$9,580. Geo. S. W. Bubaker, Lancaster, Pa., \$15,990. Stern & Silberman, Philadelphia, Pa., three bids:—Alternating plant, \$9,575; multiphase plant, \$10,975; direct current, \$14,261. McCay-Howard Engineering Co., Baltimore, Md., \$9,850. Pennsylvania General Electric Co., \$9,998. LaRoche Electric Works, Philadelphia, Pa., \$8,875.

DISCRIMINATING LIGHTNING ARRESTERS.

By permission of the American Institute of Electrical Engineers, Mr. A. J. Wurtz' valuable and interesting paper under the above title has been reprinted for general distribution by the Westinghouse Electric & Mfg. Co. The pamphlet contains the discussions in Chicago and New York and deserves to be widely read.

WESTERN NOTES.

THE NORTHERN ELECTRIC Co. has just been organized at Chicago by George W. Furbeck, Jos. Kettlestrings and W. I. Marshall. The capital stock is \$25,000.

GENERAL MANAGER BUTLER of the Indiana Rubber and Insulated Wire Co., Marion, Ind., was in Chicago last week and reports a noticeable improvement in the business.

THE METROPOLITAN ELECTRIC COMPANY have just arranged to take the product of a well-known glass factory for insulators, and they will be able to furnish the market with standard grades of insulators at factory prices. A large stock will always be kept on hand and immediate shipments can be made.

A HORRIBLE POSSIBILITY. The Chicago *Times*, in a recent issue tells about a certain Ed. Brady who was electrician for the Alhambra Theater, but was discharged for drunkenness. Out of revenge, Brady "destroyed the switchboard for the electric plant and took out all the fuses." Luckily he was discovered in time by the watchman and a terrible catastrophe averted, for "when the switch putting the current in motion would be turned, fire would have broken out in 100 different places."

THE BELVIDERE TELEPHONE Co., Belvidere, Ill., has been incorporated with a capital stock of \$5,000 by W. M. Marean, O. H. Wright, Jr., and others.

THE NOKOMIS, ILL., ELECTRIC LIGHT & POWER Co., capital stock, \$10,000, was incorporated last week by R. E. Cornelius, George Bliss and Garrett Carstens.

MR. JOHN R. MARKLE, Manager of the Western Department Office of the Electric Storage Battery Co., announces the sale to the Merrill Railway & Lighting Co. of Merrill, Wis., of a storage equipment of 240 kilowatts capacity. This is to be used in conjunction with the street railway generator at present in use, and also to supply a number of street lights which are run five in series. This is perhaps, the first combination in this country of a storage battery with a street railway plant, and the results will be watched with great interest by progressive street car men.

THE ELECTRIC APPLIANCE COMPANY are experiencing a brisk run on their Packard Transformer, which is making a great reputation for its close regulation on light and full loads. It is also claimed that by a peculiar method of winding an insulation is secured which precludes all possibility of a burn-out. One of the exhibition tests which can be made on any of the Packard transformers successfully is to run them under a heavy overload with the case filled with water, without in any way affecting the operation of the converter. The Electric Appliance Company challenge their competitors to show anything approaching this in the line of transformer insulation.

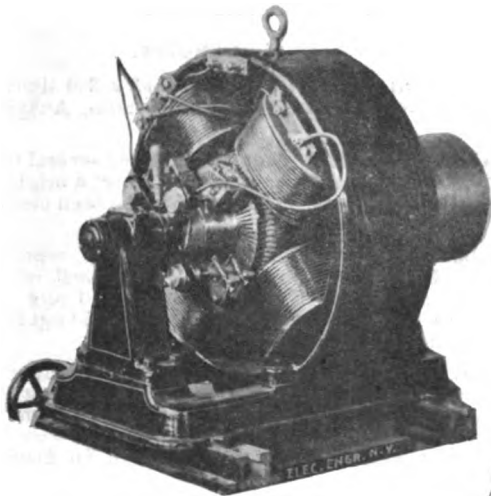
THE "VELVOCA" PRIMARY BATTERY LAUNCH IN ENGLAND.

By invitation of the Battery and Motor Company, a number of experts were present recently at the company's works, on Peter-sham Island, Richmond, England, to witness the application of the velvo-carbon battery to launch propulsion. The "Velvo," which has been specially built, is a 35-foot open boat, and has a beam of 6 feet 6 inches. The batteries, weighing 1,400 pounds, are placed in the centre, and have a cover which can be utilized for a seat, so that no space is wasted. "Velvo-carbon," it should be stated, is a special negative electrode for electric batteries, consisting of ordinary carbon with a surface of carbonized cotton velvet. Batteries employing these carbons are said to be both light and powerful, and may be used with a weak solution of sulphuric acid only as an excitant. The incorrodible connections are made of pure silver or platinum.

THE ZAHN MULTIPOLAR DYNAMO.

We illustrate in the accompanying engraving the multipolar dynamo and motor of the Electrical Manufacturing Co., Dr. G. H. Zahn, Corry, Pa. As will be seen great care has been exercised to produce an artistic design, a solidity of construction and a close adjustment of proportions within the machine.

The magnet frame is of the ring shape and cast in one piece, insuring a good magnetic circuit and great mechanical strength. The armature is of the Gramme ring type; carefully annealed sheet iron rings of the best quality are used in building up the core. These rings, after being insulated, are clamped between



ZAHN MULTIPOLAR DYNAMO AND MOTOR.

two halves of a bronze spider held together by steel bolts in the interior of the core. The commutator is of very massive design made of tempered copper and insulated with mica exclusively. The shaft, of the best machinery steel is run in self-oiling phosphor bronze bearings.

The new line of standard machines brought out by the Electrical Manufacturing Co., Dr. G. H. Zahn, are of high efficiency and guaranteed to be free from defects of workmanship and material and to run with perfect automatic regulation without sparking and injurious heating.

CHAS. E. GREGORY CO.

THE CHAS. E. GREGORY CO., of 47 and 49 S. Jefferson street, Chicago, have made the following sales: Home Electric Light and Power Co., Elkhart, Ind., one 50 light American arc dynamo, one 50 light Standard arc machine, one hundred lamps, one hundred hoods, and one hundred globes; Mrs. S. Livingstone, Chicago, one 1 H. P. Eddy motor; Eugene Vallens & Co., Chicago, one 1 H. P. Belding motor; Barrett & Barrett, Chicago, one 2 H. P. Excelsior motor; Henry Electric Co., Henry, Ill., one 80 light Sperry arc plant complete; O. H. Parker, Anniston, Ala., one 25 H. P. C. & C. motor; Ford & McGregor, 21 Edison arc lamps; F. Braasted, Ishpeming, Mich., one 5 H. P. Thomson-Houston motor; D. & C. Goodyear, Tomah, Wis., one 8 H. P. Jenney motor; Hatch Cutlery Co., Buchanan, Mich., one 25 k. w. Edison motor; Taylor, Dee & Mack, Chicago, one 2 H. P. Sprague motor and one 10 H. P. U. S. motor; W. Kreilow, Willow Springs, Mo., four "D" T.H. arc lamps; Lederer & Oppenheimer, Chicago, fourteen Edison arc lamps; Four Lakes Light and Power Co., Madison, Wis., one 3 H. P. Jenney and one 8 H. P. Eddy motor; Crane Elevator Co., Chicago, one 1 H. P. Crocker-Wheeler motor; Goltz & Sinclair, Milwaukee, Wis., one 1 H. P. Eddy motor; Racine Dredging Co.,

Gladstone, Mich., one 8 light Excelsior arc plant; Field Columbian Museum, Chicago, one 45 light Brush arc dynamo and forty-five lamps; D. S. Huff, Morris, Ill., one 1½ k. w. Edison motor; Chicago Turngemeinde, Chicago, one 5 H. P. Excelsior arc motor; Dundee Rapid Transit Co., Elgin, Ill., one 20 H. P. Sprague motor; Quincy Floor Plate and Mfg. Co., Quincy, Ill., one 50 light U. S. dynamo; Metropolitan Electric Co., Chicago, one 7 light Bain dynamo.

THREE-WIRE DISTRIBUTION FROM ONE GENERATOR.

Ever since the three-wire system of distribution came into existence, attempts have been made to effect the same result by the employment of one machine instead of two, as now universally employed. Theoretically, there would seem to be no difficulty in operating in this manner, but all attempts to do so in practice have thus far met with failure, owing to the uncontrollable sparking. This difficulty, has, it is claimed, been successfully overcome by the Fuller "double voltage" constant potential generator built by the Fontaine Croesing and Electrical Co., of Detroit, Mich.

This machine can be connected to any three-wire system without any change in the present wiring of a building, as well as for the two-wire system for either voltage. Thus, where lighting at 110 and power at 220 volts are wanted from the same circuits, a single machine suffices for both.

In addition to the saving in cost of one machine, there is the saving of belting, shafting, clutches, foundation, and in floor space.

The machine is so designed that any number of horse power, up to the limit of the machine, can be taken at either voltage, or both at the same time, in any proportion, the voltage remaining constant from zero to full load, with the brushes practically fixed. These machines are built in sizes from 10 to 100 H. P. and embody the latest and most approved mechanical construction. The company guarantees the proper working of every machine for two years.

ELECTRICAL MICA.

Messrs. Eugene Munsell & Co., of 218 Water street, this city, have a way of coming out with just what is needed, at just the time that the need is most apparent. The latest addition to their mica specialties is a complete set of standard stamped solid sheet mica segments, ready to use, for street car motors, rheostats, etc., and they are also prepared to furnish special shapes of any design. The mica used for these segments is of two grades, known respectively as "India sheet" and "Amber sheet" mica. The pieces are carefully selected and closely trimmed so that there is little waste. The little folder recently issued by the firm calling attention to the standard segments also states that "micanite" is the best insulator on earth, and enumerates the principal forms in which it is constantly kept in stock.

THE STATUS OF THE STANDARD ELECTRIC CO.

WITH regard to the recent legal proceedings mentioned in these pages, affecting the Standard Electric Co., of 20 North Fifth Street, Philadelphia, makers of automatic time cut outs for electric lights, regulating sockets, etc., we have the following communication from the company, per R. E. Difenderfer, general manager:—

We desire to state that James F. McLaughlin did file a bill of equity against Robert E. and James W. Difenderfer and T. H. Gehly, and asked for the appointment of a receiver. He (McLaughlin) asked also that he be made the receiver. The three defendants invested all the money for the past two years, McLaughlin never having a cent in the business, yet through this move his desire was to get control of the business. The machinery formerly owned by McLaughlin was held under an absolute bill of sale. He had neither right, title nor interest in same.

The reason for moving the machinery, tools, &c., was the result of schemes laid by McLaughlin as far back as last February when he locked the workroom against the remaining partners and pursued work on his own account to the disadvantage of those interested with him in the co-partnership.

Please give currency to the fact that Robert E. Difenderfer, James W. Difenderfer & Theodore H. Gehly have full and entire control of everything belonging to the Standard Electric Co. including patents for full term of patents properly assigned, machinery, tools, stock etc.; McLaughlin having no interest in the said Standard Electric Co. whatever.

We are now fully prepared to go ahead and supply the trade as soon as devices can be made. We are prosecuting our work as rapidly as possible and will inform you as we proceed.

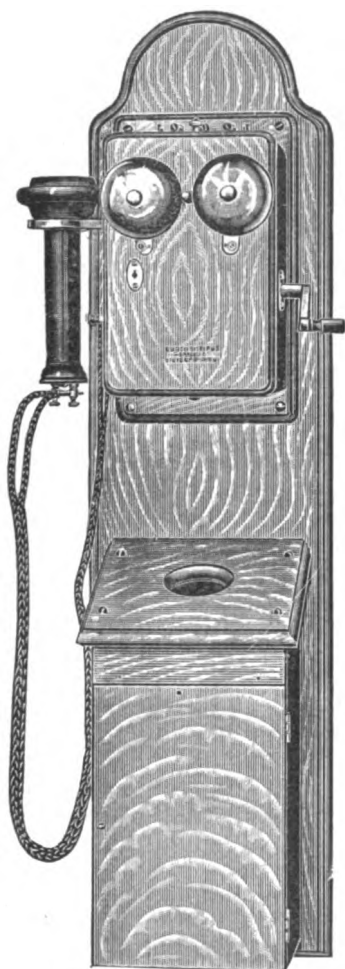
THE ELECTRIC APPLIANCE COMPANY have arranged to represent the Heislser series lamp exclusively in the West and carry a large and complete stock in Chicago. The advantage of this will undoubtedly be appreciated by users of series incandescent lamps who have heretofore been compelled to send their orders to Eastern houses for shipment direct from Eastern points. The Heislser series incandescent lamp is too old and well known an article to require comment, and the Electric Appliance Company have added another good specialty to their stock.

BALL ENGINES IN THE WEST.

Mr. J. H. Parshall, Detroit representative of the Ball Engine Co., Erie, Pa., is installing a 70 H. P. engine of this manufacture in the building of the Edson-Moore Co., Detroit. The Ball Engine Co. have the contract for furnishing the engine for electric lighting in the new Industrial Home for the Blind, in the City of Chicago. This engine is to be direct connected to an Edison dynamo.

THE ANTHONY TELEPHONE.

The Anthony Electric Co., of the Perin Building, Cincinnati, Ohio, are making telephones for general exchange use and also for direct communication in hotels, offices, public buildings, etc. The instrument shown in the accompanying illustration is one they recommend for general use, and is the result of much study



THE ANTHONY TELEPHONE.

and experiment. The instrument is encased in an oak cabinet, with compound magnetic receiver, and the trimmings are of brass and nickel plate, presenting a handsome appearance. A new portable desk telephone is now being introduced by the same company.

THE FERRACUTE MACHINE Co., Bridgeton, N. J., are quite busy, running on full time and having orders in for five or six weeks ahead. Among other machinery they are building a large double-column cutting press, weighing 20,000 lbs., for the General Electric Co. of Schenectady, and have recently shipped a smaller press of this kind with dies for armature discs and a smaller press with dial notching attachment for cutting the teeth in armature discs to the Jeffrey Mfg Co. of Columbus. They have a number of presses which are especially adapted for electrical work, and their machinery is found in almost all the large electrical factories in the country, and has proved very satisfactory. They are building some special presses with dial feeds for a firm in New York, and some special machinery for the Standard Oil Co. They have just shipped a very handsome press to the Frankford Arsenal, Bridesburg, Phila., with double feed attachment and gang dies, etc. for making cartridge shells.

SALES OF MATHER APPARATUS.

The Mather Electric Company of Manchester, Conn., report the following recent sales in their Isolated Lighting Department: North Packing and Provision Co., Somerville, Mass., 1,000-light dynamo (third order); Hermann, Aukam & Co., Lebanon, Pa., 600-light dynamo; Church Green Electric Light and Power Co., Boston, 600-light dynamo (ninth order); Iowa School for the Deaf, Council Bluffs, Iowa, 600-light dynamo; Connecticut River Paper Co., Holyoke, Mass., 700-light dynamo, two 15 H. P. Manchester motors; Henry R. Worthington Hydraulic Works, Brooklyn, one 600-light dynamo, one 10 H. P. motor, one 45 H. P. 220 volt generator; J. B. Williams Co., Glastonbury, Conn., 150-light dynamo; Graif Bros., Lake Crystal, Minn., 150-light dynamo; Ohio State University, Columbus, Ohio 15 H. P. Manchester motor; Grenada Hotel, Chicago, Ill., 450-light dynamo; Barney & Smith Mfg. Co., Dayton, Ohio, 8 H. P. Manchester motor; B. T. Sturtevant & Co., Chicago, Ill., 10 H. P. Manchester motor; G. M. Angier & Co., Boston, Mass., 100-light dynamo; Candes Company, New Haven, Conn., 50-light dynamo; Moorehouse Bros., Chantierico, 50-light dynamo; Odd Fellows' Hall, Philadelphia, Pa., 30, 50 and 80 K. W. direct connected generators and 50 H. P. in motors; S. N. Blake, Elmira, N. Y., 350-light dynamo; Nardi, Strang Co., Philadelphia, Pa., 50 light dynamo; George W. Furbeck, Chicago, Ill., 250-light dynamo; C. B. Boothe, Los Angeles, Cal., two 5 H. P. Manchester motors and one 8 H. P. Manchester motor; Baiger Lumber Co., Kansas City, Mo., 100-light dynamo; Leaf Bros., Winchester, Va., 50-light dynamo; Stanley Laboratory Co., Pittsfield, Mass., 10 K. W. exciter; Diamond Machine Company, Providence, R. I., 800-light dynamo; West Virginia Improvement Co., Pocahontas, West Va., 60 K. W. 220 volt generator.

PHILADELPHIA NOTES.

HARRY S. SMITH & Co., LTD., have sold a 600 light Mather Ring Type Dynamo to be installed for Hermann, Aukam & Co., Lebanon, Pa.

THE LA ROCHE ELECTRIC WORKS have closed several important contracts during the past two weeks and report a bright outlook for Fall and Winter business. The late fire has been clean forgotten in the big rush of orders.

THE MILLER ELECTRIC WORKS of 4 No. Fifth St. report the sale last week of a 100 light dynamo to J. J. McConnell of Canal St. and a 75 light dynamo to England & Bryan 3rd and Vine Sts. They have also just finished the wiring of a 250 light plant for Henry Marklin at Roxborough.

MR. CHAS. W. PUTNAM, the Philadelphia representative of the Campbell Electric Supply Co., of Boston has removed his office from 55 No. 7th St. and will hereafter be found at Room 916 Betz Building. In addition to his office he has rented a commodious storehouse where will be kept a full supply of all goods sold by the Campbell Co.

NEW ENGLAND NOTES.

THE MATHER ELECTRIC Co., of Manchester, Ct., report the shipment last week of two of their 1,000 light, ring type, dynamos, with complete switchboard, for the new Davidson Theatre at Milwaukee, Wisconsin. This order was secured through J. Holt Gates of Chicago, the western contractor for the Mather Company.

MR. C. R. HUNTLEY, of the General Electric Co. of Buffalo was a visitor to New York last week. He reports that company to be in excellent shape again after its various renewals and renovations, and, what is better yet, the improvement in trade is bringing the demand for current back to its own level. Mr. Huntley is resting for a while and is employing a hardwon leisure in doing his best to elect both the State tickets, as a compliment to the personal friends he has on each.

MR. J. W. MORRISON, long time the representative of the Fort Wayne Company has resigned his New York State and Canadian agency, at Syracuse, N. Y. His record, as a salesman is simply marvelous, and if anything "got away" in his territory it was not for want of energy on his part. During the past six or seven years he has sold, of the Wood system, 4,360 arcs, and 36,600 incandescent, with dynamo capacity to match, representing roundly about \$1,400,000 worth of apparatus.

Departmental Items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.

Vol. XVIII

OCTOBER 17, 1894.

No. 337.

THE RIKER STORAGE LAUNCH OPERATED FROM
TROLLEY CIRCUIT AT STAMFORD, CONN.

THE charging of storage batteries for electric launches is perhaps more wholly dependent upon arbitrary conditions than any other class of electrical work. Where large numbers of launches are operated and warrant the erection of a special generating plant, there are no extraordinary complications, but generally such is not the case, and power must be taken from the nearest existing source of supply and adapted to the requirements of the launches as best it may. The methods employed are often ingenious and interesting.

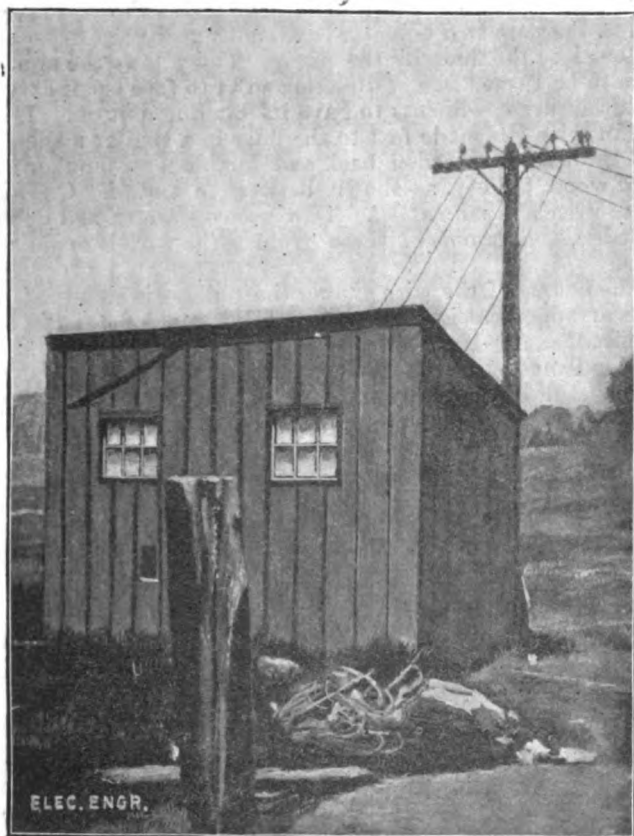


FIG. 1.—THE CHARGING STATION.

Mr. Andrew L. Riker, who has devoted so much time to electric launch work, has a charging station at Stamford, Conn., which is unique. There is but one boat to be charged and current is taken from the trolley circuit a quarter of a mile distant. The launch is 22 feet long, 5½ feet in beam and draws two feet of water. The motor, shown in Fig. 4, is of the Riker water-

proof type for launches, of two H. P. capacity at 1,000 revolutions per minute and is directly coupled to the propeller shaft. A 12 inch, 3 bladed screw of 12

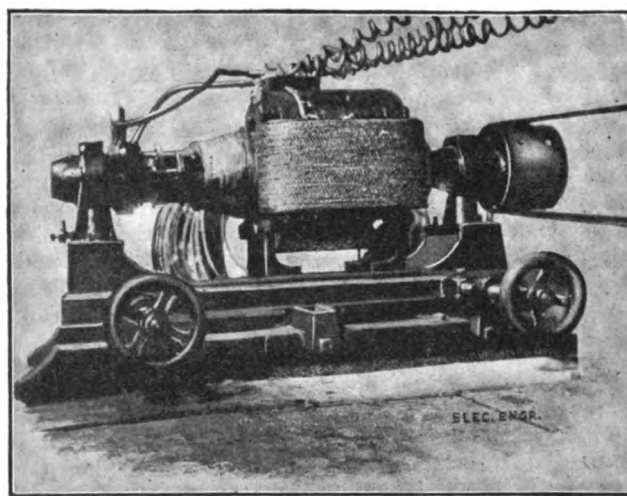


FIG. 2.—500 VOLT MOTOR.

inches pitch is used, and four separate speeds, from 4½ to 8 miles an hour, are provided for by a series parallel controller. At a ten hour discharge a cruising range of 45 miles is possible. Twenty-four cells of storage battery, of 200 ampere hour capacity, furnish the current, and the total weight of the electrical equipment is 1,400 pounds—1,230 for the batteries and 170 for the motor.

The launch is charged from the Stamford Street Railway Co.'s power plant, that being the only current available, and as the batteries only need 75 volts, Mr. Riker

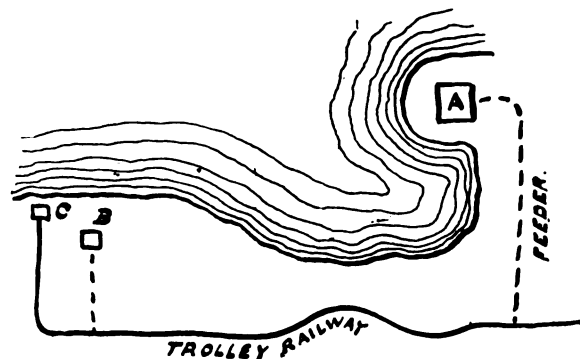


FIG. 3.

decided to use a 5 H. P. 500 volt motor and belt it to a 75 volt generator of three kilowatts.

The charging station and the motor are shown in Figs. 1 and 2, and Fig. 3 shows the relative position of the for-

mer with regard to the railway power house and the track. The power house A stands on a point of land about a mile from the road, and from the point where the feeder joins the trolley wire to where the launch circuit leading to the charging station B is tapped in, is two miles more. The latter line is, as before mentioned, a quarter of a mile, so that the distance by wire between the two stations is three

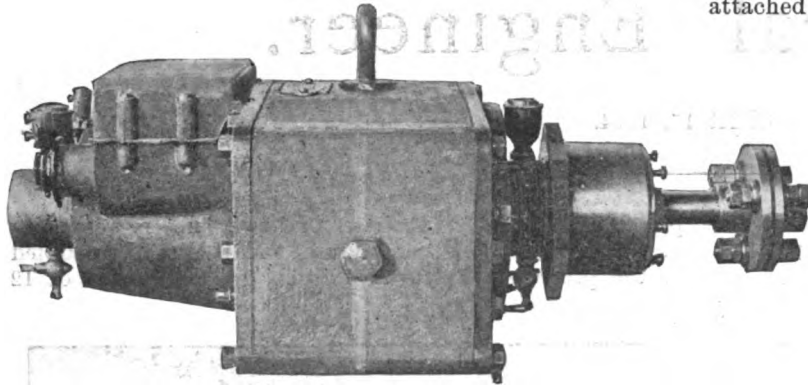


FIG. 4.—RIKER WATERPROOF LAUNCH MOTOR.

miles and a quarter. The terminus of the road is seen at c. As the rails are used for the return circuit and no supplementary wire is employed, it was thought best to run two wires from the railway to the station. These are supported on a line of poles and pass into the building through a line lightning arrester to the switchboard. The latter contains on the right hand side the voltmeter and the automatic and main switch for the generator, and on the left the automatic and main switch for the motor.

The current passes from the generator through a Bristol recording ammeter and out to the moorings through 500 ft. of cable laid in the water. This cable is buoyed and, when not charging the launch, rests at the bottom of the Sound. Careful tests of the efficiency of the plant show 70 per cent.

One objectionable feature of the arrangement was the drop of potential in the railway circuit when the cars were near the charging station and two miles away from the feeder. To overcome this trouble it is necessary to use a much higher rate when the cars are off the line than the batteries were intended for.

The plant is entirely automatic and may be started in the evening, after the launch is tied up for the night, and left to itself. It has been working satisfactorily all summer.

ELECTRICAL MACHINIST PRACTICE.—V.

BY

James F. Hobart,

THE amount of centrifugal force developed on the periphery of an armature while revolving at high speeds, is considerable. In a ten inch armature running at the rate of 1,000 revolutions per minute the centrifugal force developed is greater than the uninitiated have any idea of. It is sufficient to throw the armature winding out of shape unless confined by stout binding wire which should be wound on very tight, and soldered so as to never come off accidentally.

Where the heads (ends) of an armature are covered with canvas or ducking, the fabric should be held in place by the wire binding as shown in Fig. 20 at *g*. This wire is usually a spring tempered brass or german silver of high tensile strength. Iron and steel wire has been used for the purpose, but its magnetic properties render it undesirable

for that purpose. Some tin clips, *a, a, and h*, are laid underneath the wire, from four to six being distributed at equal spaces around the armature, as shown at *a, a*. After the winding is in place, the clips are bent up over the wire as at *h*.

The canvas covering *c* must be laid very smoothly in place before the winding (*g*) is put on. If necessary, the canvas should be fastened by strings or wires *d, e, f*, etc., attached to the canvas and either passing around the shaft

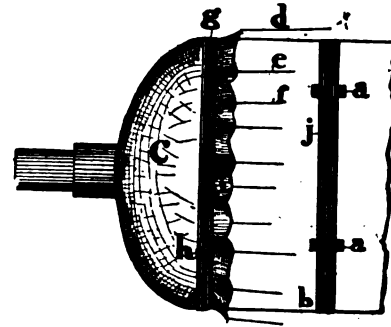


FIG. 20.

at the other end of the armature, or the same strings may be made to hold both canvas coverings in place. The binding wire is such "kinky" stuff that some kind of a tension is absolutely necessary in winding it on, and Fig. 21 shows one form of tension apparatus and its method of application.

A plain piece of bar iron is bent up, as shown at *a, c* and *d*, the part at *a* being twisted and punched so as to be fastened to the floor by the pin *a*. This allows the appliance to be turned in any direction so as to face squarely to the armature *e*, which is to have its binding put on. The reel of wire *b* is made fast to the floor in a similar manner, and the wire is threaded back and forth over a number of hard wood pulleys, as shown, between *c* and *d*. One of these wheels is shown at *j*. Two grooves are turned upon its edge, and in one of these grooves the wire is made to pass.

The course of the wire among the pulleys is shown at *f*. This arrangement is used when a good deal of tension is required, as for large wire on big armatures. When less tension is needed, some of the pulleys are skipped, as at *g*, and a still lighter tension is secured by the arrangement

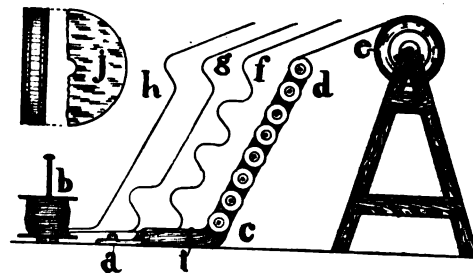


FIG. 21.

shown at *h*, where only the bottom pulley, and two at the top, are employed.

One great defect of this tension apparatus, is in the liability, (and persistence) of the wire to kink as it comes off of the reel, and then to run off of the first pulley *c*. This tendency is checked by twisting a wire around the bar as shown at *i*. It could also be remedied by putting a heavy weight, or spring on top of the reel at *b*.

Another form of tension, which I like very well, is illustrated in Fig. 22. This tool may be made of brass, steel, iron or wood. It consists of two pieces exactly alike, as shown in the engraving. The bolts and thumb nuts

enable any required amount of pressure to be put upon the wire. The metal strips are lined at the ends with pieces of fibre (*b* and *c*), and a cord *a*, fastens the tension apparatus as desired. By regulating the thumb nuts, any desired amount of tension can be applied.

Another very cheap tension apparatus, suitable for very small motors and armatures, and bench work in general, is the one illustrated in Fig. 23. It is made out of a bit of broomstick eight inches long, split, as shown, at *a*, and lined with two bits of fibre which are screwed against the wire by the screw *c*. The arrangement of this handy little tension is shown at *b*, where it is attached by means of the cord or

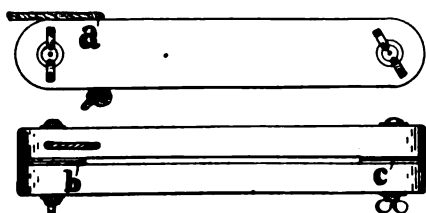


FIG. 23.

wire *d* to the runner *a*. This is made of $\frac{3}{4}$ inch round iron, the ends sharpened and turned up like a staple, then driven into the bench. The tension stick is thus allowed a lateral travel of about eight inches in which to adjust itself at right angles with the armature to be worked on.

To start a strip of binding wire, first adjust the reel, tension, etc.; then take a turn of wire around the armature at least one inch from where the strip of binding is to be located. Fasten the wire (by twisting) and wind a spiral of one or two turns until the right place to commence the strip has been reached. Put the clips under the first turn of wire, taking care to arrange them exactly as wanted, so as not to have to spend time in changing the clips after the wire is all on. The man who is revolving the armature should watch the binding wire and turn very slowly when the wire is behaving badly. A little more speed can be used when the wire winds on nicely, but at all times the speed of revolution should be free from sudden jerks, stops and starts. The variations from slow to faster revolution must be easy and smooth. It requires as good a man at the crank lever as it does at the wire reel.

Binding wire should be wound on in the exact place it

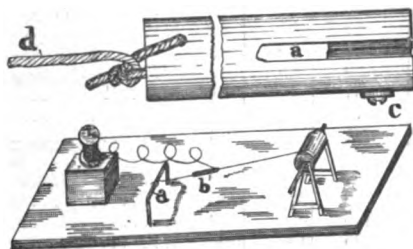


FIG. 23.

is to occupy, and each single turn of wire is no exception. That is, it should be wound closely together, and each turn free from kinks and bends. Every effort made to straighten or drive together the turns of wire loosens the coil; therefore the wire should be put on right "by first intention," as surgeons say when speaking about the healing of flesh wounds. To make the binding wire lie smooth and close together, the tension must be great enough to take out all the kinks, and the "winding on" wire must be so held as to lead on to the turn already in place.

In holding or guiding the wire so that it runs on to the last turn wound, do not guide it far enough so it will ride upon

the top of, and jump over the last turn. Such an occurrence would spoil the whole strip and rewinding becomes necessary. As soon as the required number of turns of wire are in place, let the turner hold the crank lever very still, while you dab in a little soldering mixture and with the copper (already heated) drop a little solder on the coil, just sufficient to hold them together, so that the turner may let go his hold, and the extra turns of wire may be clipped off.

Take care to have the ends of the wire come upon the little tin clips already mentioned, and the outside wires should be soldered just back of the clips upon which they are to terminate. This soldering should be done while the wire is under tension, that is, before the extra coils have been cut off. By taking a little care, the "winding on" end of the wire may be soldered close to a clip when the first fastening is done. Then that end of the wire may be cut off at once leaving the starting end still under tension, so that it may be soldered and cut off at one's leisure.

Great care must be taken to avoid too much tension in the binding wire. Many times I have seen careless men break the wire by trying to use excessive tension. If the wire break when the binding strip on coil is nearly wound, the wire already in place is wasted. The coils jump off instantly, and the usual practice is to apply the wire cutter promiscuously, cutting that 20 or 30 feet into short pieces and then carefully stowing them away in the waste barrel. Too great tension of the binding wire undoubtedly strains and permanently injures it and may be responsible for the damage occasioned by failure of the binding.

MAGNETIC LEAKAGE IN DYNAMO-ELECTRIC MACHINERY.—VI.

BY

Alfred E. Whipple.

II. Calculation of Leakage Factor from Machine-Test.

The machine having been built, its actual leakage can be determined from the ordinary machine-test. It is only necessary, for this purpose, to run the machine at its normal speed, and to regulate the field-current—by changing the series-regulating resistance in a shunt-dynamo; or by altering the number of turns, in a series machine, or by regulating both, in a compound wound dynamo—until the required output is obtained. Noting then the exciting ampere-turns, we can calculate the total magnetic flux, Φ' , through the magnet-frame, by a comparatively simple method which is given below; and Φ' divided by the useful-flux, Φ , gives the factor λ of the actual leakage.

A. Magneto-Motive Forces.

The observed magneto-motive force of A *T* ampere turns per magnetic circuit—made up of T_s shunt-turns, through which a current of $A_s = \frac{e}{r_m}$ amperes (e = potential at terminals, r_m = total resistance of shunt circuit) is flowing, in a shunt machine; or of T_s series-turns traversed by a current of $A_s = e$ amperes (e = current output of dynamo), in a series machine; or partly of the one and partly of the other, in a compound dynamo—is supplying the requisite magneto motive forces used in the different portions of that circuit, viz., the ampere turns needed to overcome the magnetic resistances of the air-gaps, of the armature-core, and of the field-frame, and the magneto-motive force required to compensate the reaction of the armature winding upon the magnetic field; hence we have:

$$A T = at_e + at_a + at_m + at_c, \dots \dots \dots (49)$$

where $A T$ = Total magneto-motive force required per magnetic circuit for normal output, in ampere-turns, observed;

at_e = Magneto-motive force used per circuit to overcome the magnetic resistance of the air-gaps in ampere-turns, see (52);

at_a = Magneto-motive force used per circuit to overcome magnetic resistance of armature-core, in ampere-turns, see (55);

at_m = Magneto-motive force used per circuit to overcome magnetic resistance of magnet-frame, in ampere-turns, see (50);

at_c = Magneto-motive force required per circuit for compensating armature-reactions, in ampere-turns, see (65), (66) and (67).

Since the magnet-frame alone carries the total flux generated in the machine, while the air-gaps and the armature-core are traversed by the useful lines, only the ampere-turns used in overcoming the resistance of the magnet-frame depend upon the total magnetic flux, and all others of these partial magneto-motive forces can be determined from the useful flux. The latter, however, is known from the armature data of the machine by virtue of equations (1) or (2), respectively; consequently from (49) we can determine at_m , and this, in turn, will furnish the value of the total flux, Φ' .

Transposing (49), we obtain:

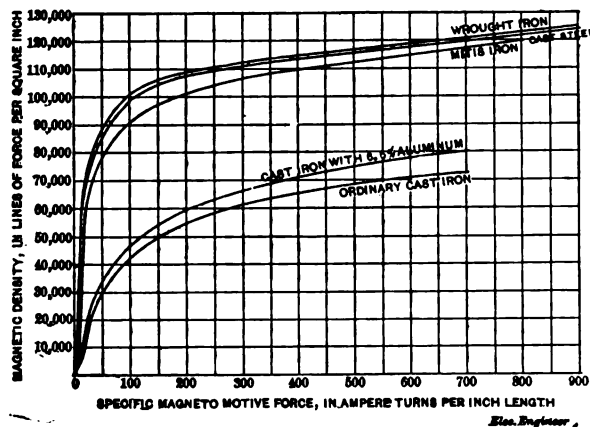


FIG. 51.

$$at_m = A T - (at_e + at_a + at_c), \dots \dots \dots (50)$$

in which $A T$ is known from the machine test, at_e and at_a can be calculated from the useful flux, and at_c is given by the data of the armature.

a. General formula for computing the Magneto-Motive Force required for any portion of a magnetic circuit.

For the magnetic circuit a law holds good similar to Ohm's law for an electric circuit, viz.:

$$\text{Magnetic Flux} = \frac{\text{Magneto Motive Force}}{\text{Reluctance}},$$

or,

$$\text{Magneto-Motive Force} = \text{Magnetic Flux} \times \text{Reluctance}.$$

Again, the reluctance of a magnetic circuit, similar to the electric case of resistance, can be expressed by the specific reluctance, or reluctivity, of the material, and the dimensions of the magnetic conductor, thus:

$$\text{Reluctance} = \text{Reluctivity} \times \frac{\text{Length}}{\text{Area}}.$$

Combining these two laws, we obtain:

$$\text{M. M. F.} = \frac{\text{Magnetic Flux}}{\text{Area}} \times \text{Reluctivity} \times \text{Length},$$

and since the quotient of the magnetic flux by area is the magnetic density, we have:

$$\text{Magneto-Motive Force} = \text{Magnetic Density} \times \text{Reluctivity} \times \text{Length}.$$

The product of the magnetic density and the reluctivity of the material at that density gives the magneto-motive force required per unit of length; in order to obtain the magneto-motive force for any material, any density and any length, therefore, we have to multiply the specific magneto-motive force for the respective material at the density required, by the length of the circuit:

Table III.—Specific Magneto-Motive Forces of Various Materials for Different Densities.

Magnetic Density. Lines of Force per square inch.	UNIT MAGNETO-MOTIVE FORCES. Ampere-Turns per Inch Length.					
	Annealed Norway Iron.	Soft Cast Steel.	Mild Iron.	Cast Iron, containing 6.5 % of Aluminum.	Cast Iron (ordinary)	Air. (= .3138 × H)
2,500	1.2	2	2.5	7	9	788
5,000	1.7	2.8	3.4	9.6	13	1,566
7,500	2.1	3.4	4	11.6	16	2,350
10,000	2.3	3.7	4.4	13.5	18.5	3,133
12,500	2.4	4	4.8	15.7	21.3	3,916
15,000	2.7	4.3	5.2	18.2	24.1	4,700
17,500	3.1	4.6	5.6	21	27.1	5,488
20,000	3.5	5	6	24	30.5	6,266
22,500	4	5.4	6.5	27.2	34.5	7,050
25,000	4.5	5.8	7	31	39	7,833
27,500	5	6.2	7.5	35.5	44	8,616
30,000	5.5	6.6	8.1	41.5	50	9,400
32,500	6	7.1	8.7	47.5	57	10,183
35,000	6.5	7.6	9.4	54	65	10,966
37,500	7	8.2	10.1	62	76	11,750
40,000	7.5	8.8	10.9	72	88	12,533
42,500	8	9.4	11.7	83	101	13,316
45,000	8.5	10.1	12.6	95	116	14,100
47,500	9	10.9	13.6	110	136	14,883
50,000	9.6	11.8	14.7	128	160	15,666
52,500	10.3	12.8	15.9	149	189	16,450
55,000	11.1	13.9	17.3	173	222	17,233
57,500	12	15.1	19	200	257	18,016
60,000	13	16.4	21	230	295	18,800
62,500	14.2	17.8	23.2	268	340	.....
65,000	15.7	19.3	25.6	300	400	.....
67,500	17.5	20.9	28.5	345	470	.....
70,000	19.6	22.7	32	400	570	.....
72,500	22	24.7	36	460	700	.....
75,000	24.7	27	41	525	.....	.....
77,500	27.7	30	47	600	.....	.....
80,000	31.3	34	54	700	.....	.....
82,500	35.2	39	62	.....	.....	.....
85,000	39.7	44	70	.....	.....	.....
87,500	44.7	50	80	.....	.....	.....
90,000	50.7	57	92	.....	.....	.....
92,500	58	65	109	.....	.....	.....
95,000	67	75	131	.....	.....	.....
97,500	78	86	159	.....	.....	.....
100,000	91	100	193	.....	.....	.....
102,500	108	121	245	.....	.....	.....
105,000	137	159	290	.....	.....	.....
107,500	190	227	345	.....	.....	.....
110,000	290	325	410	.....	.....	.....
112,500	395	430	500	.....	.....	.....
115,000	500	550	600	.....	.....	.....
117,500	600	650	700	.....	.....	.....
120,000	700	750	800	.....	.....	.....
122,500	800	850	.....	.....	.....	.....
125,000	900	950	.....	.....	.....	.....

$$\text{Magneto-Motive Force} = \text{Specific M.M.F.} \times \text{Length}.$$

Denoting the density by B , the specific magneto-motive force (being a function of the same), by fB , and the length of the circuit by l , the ampere-turns required for any portion of a magnetic circuit can be calculated from the general formula:

$$at = fB \times l, \dots \dots \dots (51)$$

The values of the specific M.M.F., fB , for various

densities, as averaged from a great number of tests by Ewing¹, Negbauer², Kennelly³, Steinmetz⁴, Thompson⁵, and others, for the various materials are compiled in the accompanying Table III, which gives the specific M.M.F. in ampere-turns per inch length:

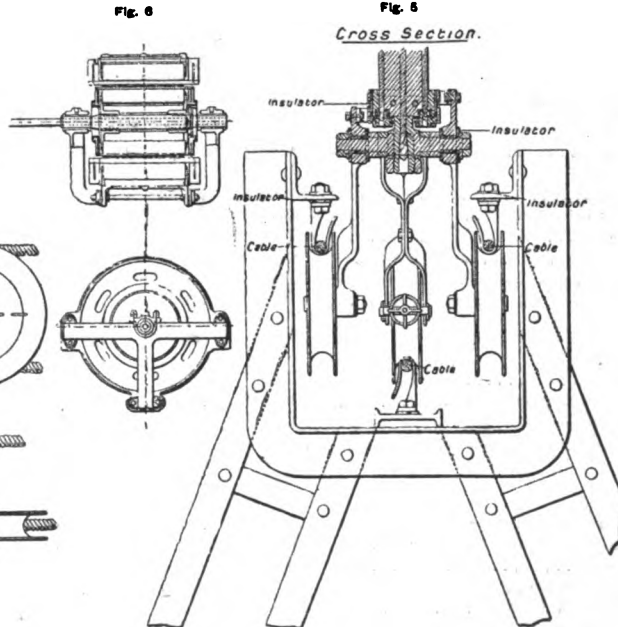
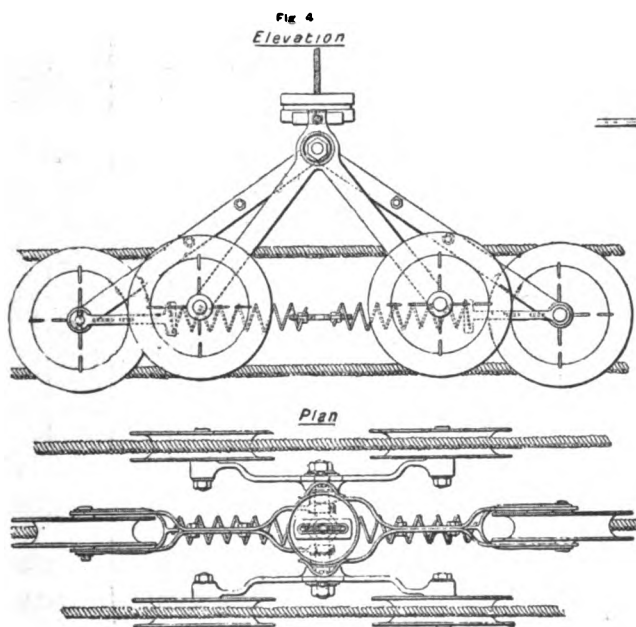
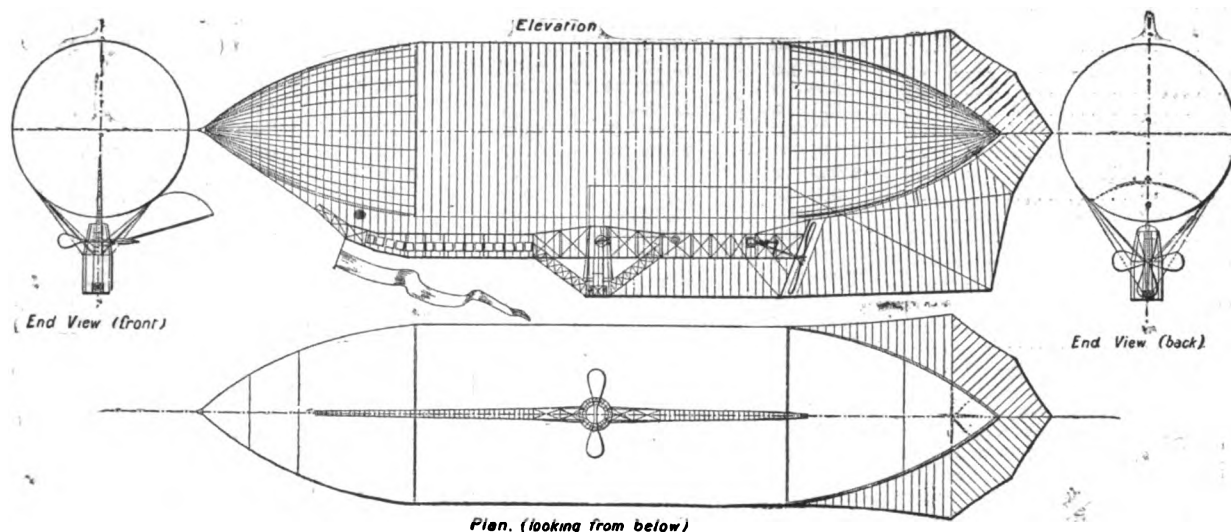
For convenient reference, the values of $f B$ contained in Table III for the various kinds of iron, are plotted in Fig. 51.

THE ANTWERP TROLLEY BALLOON.

THROUGH the courtesy of *The American Engineer and Railroad Journal*, we reproduce working drawings of the navigable trolley balloon at the Antwerp Exposition. The current is gene-

of the trolley, Figs. 4 and 5. The current is conveyed from the generating station by three parallel cables of galvanized steel wire one inch in diameter, each 1,400 yards long and in one piece.

The general arrangement of the balloon is shown in Fig. 8. It is made of linen, specially woven for the purpose, and coated with three layers of varnish. Instead of a net, an outer envelope of the same linen is used; the weight of the double covering being about 4 tons. It is spindle shaped, 57 feet in diameter, and from the foremost point to the end of the rudder measures 284 feet. Its capacity is 500,000 cubic feet. A valve at the top for letting out the gas has a *papier-maché* frame, 4 feet in diameter, and weighing only 70 lbs. The car is made of steel gas piping, covered with wickerwork, and, as may be seen by the illustration, is of very peculiar shape. The centre is cylindrical, eight feet in diameter, and reaches down much lower than the front and back portions. Of these the front is intended for pas-



THE ANTWERP TROLLEY BALLOON.

rated by two 200 H. P. gas engines driving Oerlikon generators, and a complete gas plant has been erected by an English company for inflating the balloon. The cables are supported upon six steel lattice trestles, 100 feet high, placed in the form of an inverted V, spanning the street, which is 80 feet wide. The arrangement of the top of the trestles will be seen very clearly from the drawing

sengers; it is entirely closed, but with windows. The back is for the crew, and contains the Oerlikon motor for transmitting the power to the screw. This is shown in Fig. 6. Its casing is of *papier-maché*, and although it is capable of transmitting 125 H. P., its weight is a little under a ton. The screw has four blades, its diameter is 26 feet, and M. Leon Champy, the inventor, has calculated that in calm air the balloon will be able to travel 25 miles an hour, and that consequently he will have sufficient force at his command to be able to drive the balloon against a strong wind. The connection between the three cables and the dynamo in the car is made by an elastic cable, which, passing over a drum with an automatic coiling arrangement in the car, terminates in the trolley shown in Fig. 4. The captain's station is in the cylindrical portion of the car, from which he will be able to increase or diminish the speed of the balloon, as well as to raise, lower, and steer it.

1. J. A. Ewing, "Magnetism in Iron and other Metals," "The Electrician" (London), 1890-91.
 2. Walter Negbauer, *THE ELECTRICAL ENGINEER*, ix, p. 56, Feb. 1890.
 3. A. E. Kennelly, *Trans. Am. Inst. El. Eng.*, Vol. viii., p. 485, Oct. 27, 1891; *THE ELECTRICAL ENGINEER*, xii, p. 508, Nov. 4, 1891; *Electr. World*, xviii., p. 350, Nov. 7, 1891.
 4. Chas. P. Steinmetz, *Trans. Am. Inst. El. Eng.*, Vol. ix., p. 8, Jan. 19, 1892; *THE ELECTRICAL ENGINEER*, xiii., p. 91, 121, 143, 167, 261, 283, Jan. 27, Feb. 3, 10, 17, March 9, 16, 1892; *Electr. World*, xix., p. 73, 89, Jan. 30, Feb. 6, 1892.
 5. Milton E. Thompson, Percy H. Knight and Geo. W. Bacon, *Trans. A. I. E. E.*, Vol. ix., p. 250, June 7, 1892; *THE ELECTRICAL ENGINEER*, xiv., p. 40, July 12, 1892; *Electr. World*, xix., p. 436, June 26, 1892.

A FEW FIGURES ON ELECTRIC RAILWAY EXPENSES OF OPERATION.

Various statements and statistics are afloat as to the cost of trolley operation and maintenance at the present time. It seems safe to assume from the gradually accumulating data that such costs have been under rather than over-estimated. We are glad

It is very interesting to compare these with other statistics lately brought out as to still other forms of electric traction. The next table presents the work of the World's Fair Intramural Elevated Electric Road, which carried 5,808,895 passengers.

Against these figures we may now place those of the Liverpool Overhead Electric Railway as compared with the Manhattan and Brooklyn Elevateds, and in juxtaposition with these we will place

Year ending Sept. 30, 1893.		Cost of Electric Power.		Cost of Repairs to Wiring, etc.		Cost removing Ice and Snow.	
Name	Mileage	per year	per car mile	per year	per car mile	per year	per car mile
Brockton.....	868,254	17,964.81	.0208	2,429.81	.0027	8,521.56	.0089
Fitchburg & Leominster.....	823,436	7,995.76	.0248	557.69	.0017	7,778.76	.0056
Globe (Fall River).....	729,378	15,083.74	.0206	642.94	.0009	2,894.18	.0039
Gloucester.....	214,658	8,584.33	.0400	182.63	.0009	729.86	.0034
Haverhill & Amesbury.....	418,560	18,328.91	.0443			1,887.90	.0083
Holyoke.....	266,688	9,275.00	.0350	157.71	.0006	2,243.54	.0084
Interstate.....	331,563	19,764.77	.0596	853.25	.0010	1,231.07	.0087
Lowell, Lawrence & Haverhill.....	305,694	9,047.48	.0396	324.06	.0007		
Lowell & Suburban.....	1,276,257	17,558.33	.0137	1,461.80	.0001	8,108.51	.0063
Lynn & Boston.....	4,059,479	90,881.58	.0223	6,288.33	.0015	28,585.12	.0070
Merrimack Valley.....	303,983	12,458.84	.0410	701.72	.0023	3,415.25	.0112
Newburyport & Amesbury.....	258,191	7,596.16	.0294	1,093.68	.0042	2,702.00	.0104
Newton.....	265,508	9,500.00	.0860	952.64	.0036	1,322.26	.0050
Quincy & Boston.....	151,909	8,706.77	.0573	345.49	.0023	1,856.33	.0090
Springfield.....	1,441,768	43,407.84	.0301	3,810.36	.0026	12,980.93	.0090
Union.....	580,432	4,479.71	.0077	548.04	.0009	1,189.73	.0020
West End.....	18,669,809	439,902.47	.0235	99,310.52	.0053	108,905.84	.0055
Worcester.....	1,208,854	12,098.59	.0100	651.70	.0005	5,865.37	.0044
Worcester, Leicester & Spencer.....	851,851	18,671.61	.0889	1,978.41	.0056	5,859.84	.0095

to furnish here an analysis recently completed by Mr. J. A. Machado of the reports and figures of trolley roads compiled by the Railroad Commissioners of Massachusetts and embodied in their last annual report. It will be seen that Mr. Machado has taken 18 roads illustrative of various conditions of operation.

The above may be classified as follows:

	Power per car mile.	Wiring Repairs per car mile.	Removing Ice per car mile.
Large City.			
West End.....	.0209	.0060	.0055
Large Town.			
Brockton.....	.0208	.0027	.0089
Globe (Fall River).....	.0206		.0089
Gloucester.....	.0400		.0084
Holyoke.....	.0350		.0084
Newton.....	.0360	.0036	.0050
Springfield.....	.0301	.0026	.0090
	.0808	.0030	.0056
Inter-City.			
West End.....	.0269	.0060	.0055
Quincy and Boston.....	.0573	.0023	.0090
Lynn and Boston.....	.0223	.0015	.0070
Lowell, Lawrence and Haverhill.....	.0296	.0007	
	.0340	.0026	.0072
Inter-Town.			
Fitchburg and Leominster.....	.0297	.0020	.0055
Haverhill and Amesbury.....	.0429		.0033
Interstate.....	.0596		.0037
Lowell, Lawrence and Haverhill.....	.0296	.0007	
Merrimack Valley.....	.0410	.0023	.0112
Newburyport and Amesbury.....	.0294	.0042	.0104
Worcester, Leicester and Spencer.....	.0889	.0056	.0095
	.0896	.0030	.0073

the data from the City & South London Underground Electric Road.

During the half year ending June 1894, the City & South London ran 227,363 miles and carried 3,883,154 passengers.

Working Expenses of three Elevated Railways.								
Items of Cost.	Liverpool Overhead Railway, July, 1893.		Manhattan Railway, 1892.			Brooklyn Elevated Railway, 1892.		
	Pence per		Pence per			Pence per		
	Train mile.	Ton mile.	Train mile.	Ton mile.	Ton mile.	Train mile.	Ton mile.	Ton mile.
Supervision.....	0.416	0.014	2.860	0.036	0.036	1.250	0.021	0.021
Motor and train wages.....	1.694	0.056	9.725	0.122	0.061	6.650	0.111	0.055
Coal.....	0.589	0.020	4.680	0.058	0.029	4.500	0.075	0.038
Oil, waste, and grease.....	0.140	0.005	0.400	0.005	0.005	0.130	0.002	0.002
Water.....	0.010	0.0003	0.400	0.005	0.005	0.195	0.003	0.003
Stores and sundries.....	0.049	0.0016	0.277	0.003	0.003	0.295	0.005	0.005
Cleaning and repairs, rolling stock.....	0.629	0.0276	4.100	0.051	0.051	1.670	0.028	0.028
Total pence	3.727	0.1245	22.442	0.280	0.190	14.690	0.245	0.152
Passenger train-mileage.....	39,250		9,107,000			2,789,000		
Passenger ton-mileage.....	1,177,500		728,560,000			167,340,000		

We may next contrast the cable and trolley as shown in English experience, and then may turn to the unfortunate storage battery results in Birmingham.

	May.	June.	July.	August.	September.	October.	Total.	Average.	Lowest.
Pay Rolls, operation.....	\$7,150.59	\$14,678.52	\$19,259.00	\$19,904.80	\$14,466.71	\$14,774.26	\$85,229.24	\$14,204.87	\$7,150.95
Cost per train mile, all items.....	1.69	.81	.70	.63	.67	.71	5.21	.87	.63
Passengers per train mile.....	28.75	28.31	24.46	30.97	44.29	51.32	208.10	33.85	23.75
Oil per train mile in gals.....	8.99	2.88	3.44	2.49	3.56	4.86	25.72	43.86	2.49
Cost of Oil.....	\$991.88	\$1,379.89	\$2,079.88	\$1,379.17	\$2,011.66	\$2,810.79	\$10,152.72	\$1,692.12	\$991.88
Cost per train mile (of fuel).....	15.54	4.97	5.95	4.30	6.15	7.54	44.45	7.408	4.30
Operation of P. H. per train mile.....	15.46	5.61	6.15	4.21	4.08	4.20	39.71	6.618	4.08
Wages of motor men per train mile.....	8.42	6.74	6.88	6.09	6.09	6.53	40.25	6.708	6.09
Oil per passenger.....	.88	.10	.41	.08	.08	.08	.86	.172	.08

FIGURES OF THE INTRAMURAL ROAD, WORLD'S FAIR.

Table II does not include office management, etc., for which another 2 pence per car mile should be added, so that at its best, Birmingham does not present storage traction in as favorable a light as other results might if the data were obtainable. The cells used at Birmingham have been of the lead type, whereas it is claimed that the results with the alkaline type of cells used in

longest electric roads yet undertaken—one from Philadelphia to Harrisburg and the other from Gettysburg to Baltimore.

The former road is in the hands of the Pennsylvania Traction Company and has assumed practical shape, it is said, mainly through the efforts of the president of the company, Mr. John J. Patterson, who took the matter in hand two years ago, and has

CITY AND SOUTH LONDON ELECTRIC RAILWAY.

TABLE I.—PER TRAIN MILE.—PENNY.

Half-year.	Maintenance of way, works, and stations.	Locomotive and generating power.	Carriage repairs.	Traffic expenses.	General charges, taxes, &c.	Total.
June, 1891...	53	9.06	5	8.82	2.44	21.35
Dec., 1891...	63	7.89	46	8.1	2.68	19.74
June, 1892...	56	7.67	54	7.52	2.89	19.18
Dec., 1892...	43	7.11	47	6.78	2.44	17.23
June, 1893...	5	6.48	53	6.39	2.6	16.6
Dec., 1893...	8	6.23	46	6.17	2.35	15.81
June, 1894...	59	6.23	41	6.07	2.51	15.82

PER CAR MILE.—PENNY.

Trainway.	Wages.	Fuel.	Stores.	Water and gas.	Sundries.	Repairs.	Total.	Miles run.
Birmingham Cable	1.54	0	19	03	05	1.81	4.22	341,161
South Staffs Electric ..	1.03	48	43	08	06	1.08	4.06	262,604

BIRMINGHAM ELECTRIC ACCUMULATOR LINE.

TABLE I.—PER CAR MILE.—PENNY.

Year ending	Electric haulage.	Machinery.	Car repairs.	Traffic expenses.	Permanent way and buildings.	General charges.	Total.
June, 1891	5.15	29	1.93	1.34	1.14	1.05	9.9
1892	5.84	4.03	1.11	1.44	1.72	1.21	15.39
1893	6.1	4.5	0.9	1.9	1.63	1.43	16.55
1894	6.0	3.71	0.7	1.74	2.21	2.63	16.86

TABLE II.

Year ending.	Expenses per car mile.	Receipts per car mile.	Percentage of expenses to receipts.	Total expenses.	Total receipts.	Miles run.	Passengers carried.
June, 1891	9.9	15.15	65.35	5,711	8,732	138,396	1,144,718
1892	15.39	13.25	116.15	12,102	10,422	188,760	1,382,997
1893	16.55	16.38	101.04	9,721	9,623	140,993	1,257,399
1894	16.86	16.70	100.42	9,774	9,734	139,123	1,303,833

New York city showed that even with the small plant they were 10 per cent. cheaper than horses, and were at least one-third below the Birmingham figures. Such alkaline cells have been adopted for traction work in Berlin, Vienna and Hagen, which would indicate that hope is not altogether dead in storage traction, but that it may yet hold its place with the other branches of the electrical traction art.

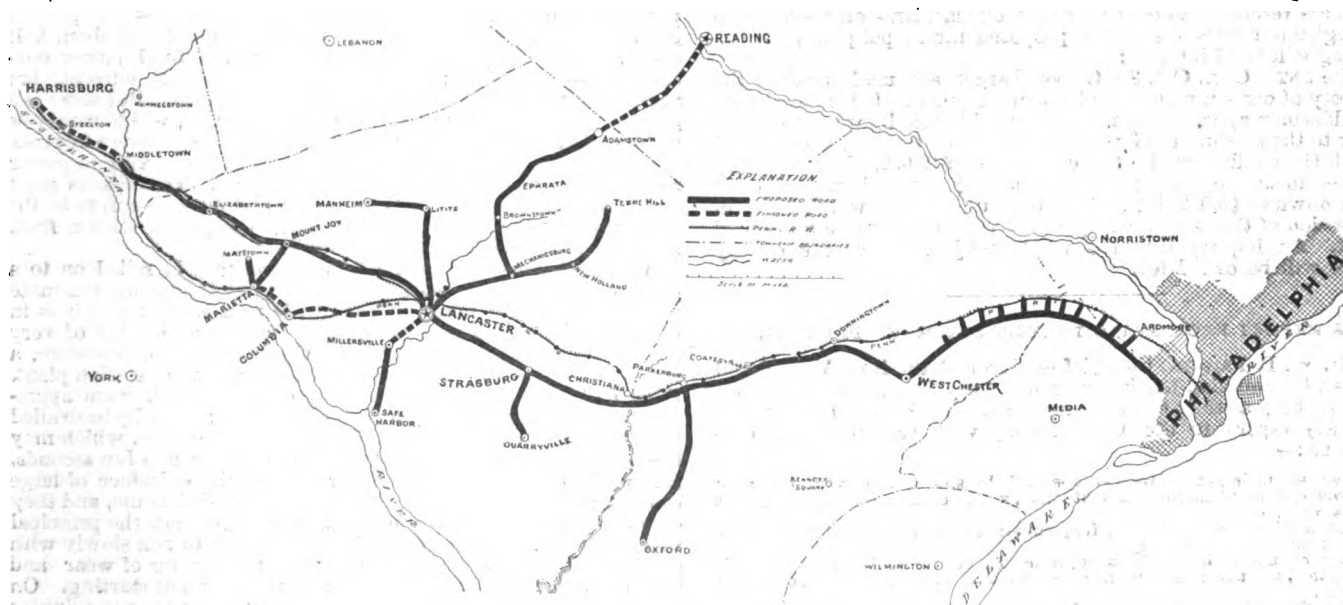
LONG ELECTRIC ROADS IN MARYLAND AND PENNSYLVANIA.

THERE is a growing tendency throughout the country to bring electric railways into direct competition with steam. In several thickly populated districts this has been so successful as to induce

already in operation in Lancaster County the system included in Lancaster City, the line to Millersville, the line to Columbia, the system in Columbia and the line from Columbia to Marietta, making in all about fifty miles of track.

The line from Lancaster to Marietta is eighteen miles long. It is laid with sixty-pound steel T rails, on a bed of one foot of broken stone ballast, and on which the cars often run at the rate of fifty miles an hour. This is considered one of the best built electric railways.

The whole system, when completed, will have about 356 miles of track, and serve a country of over 2,000,000 inhabitants, touching the county seats and market towns to insure a regular business traffic, independent of the extensive transient travel continually going on locally between the several towns, villages, dwellings and places of business all along the route. It will be double tracked. The extent of the road will be seen from the map. The



PROPOSED PHILADELPHIA AND HARRISBURG ELECTRIC RAILWAY.

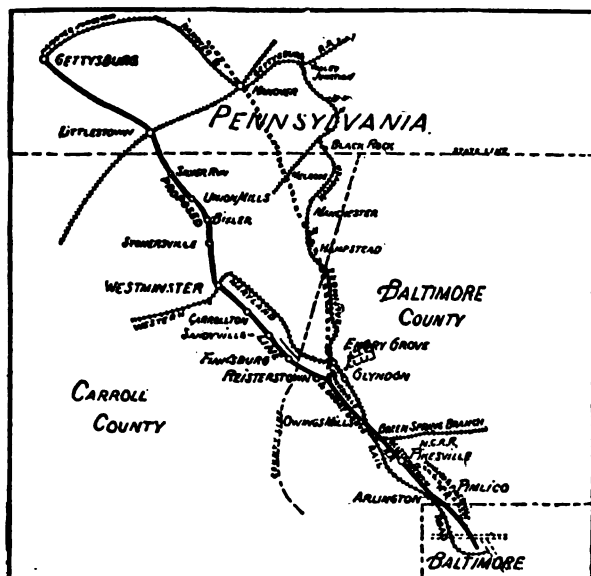
the steam roads to discontinue some of their local or suburban trains and leave this class of business entirely to the trolley.

Of the more recent enterprises of this kind are two of the

company is about to build seventy-five miles of new lines in Lancaster County. Mr. F. W. Darlington, of Philadelphia, is the consulting electrical engineer of the road.

The other proposed railway—from Gettysburg to Baltimore—is through rich farm land, thickly settled. The present turnpike between Gettysburg and Baltimore is shown by the heavy black line in the map. This, as will be seen, is nearly an air line between the termini; and this road is to be used in carrying out the project on account of its straightness and because of the many towns, large and small, that have grown up along it. The distance from Baltimore to Gettysburg by the proposed route is 50 miles, as against 73 miles by the steam railroads.

The parts of the line to be provided by different companies



PROPOSED GETTYSBURG AND BALTIMORE ELECTRIC RAILWAY.

are: The Pimlico & Pikesville Line, 7 miles, opened in 1893 from Druid Hill Park, Baltimore, to Pikesville; the Pikesville, Reisterstown & Emory Grove Railway, 9 miles, from Pikesville to Reisterstown, with an extension of $1\frac{1}{2}$ miles to Emory Grove camp grounds. Contracts for this road have been recently awarded.

The power house will be at Owning's Mills; the Westminster & Union Mills Railway, 17 miles, from Reisterstown through Westminster to Union Mills; the Gettysburg Electric Line, 17 miles, from Union Mills through Littlestown, Pa., to Gettysburg. Several miles of this line are now built south from Gettysburg across the battle field.

THE TORONTO LIGHTING CONTRACT.

WITH reference to the editorial in our last issue on the Toronto arc lighting contract and the proposed municipal plant, the following will be of interest:

TORONTO, Ont., Oct. 8.—Grave charges are made against the honesty of certain members of the city council. It is alleged that six aldermen approached the Toronto Electric lighting company prior to the sending in of the street lighting tenders, and offered to sell their influence in the council for \$12,000. The company refused to accede to their demands, and then the clique cut their price down to \$6,000, intimating that unless they were placed in possession of that amount they would vote in favor of a municipal plant. An inquiry into the whole subject before the county judge will be called for.

A REPORT FROM RAPID TRANSIT ENGINEER PARSONS.

Mr. W. B. Parsons, the chief engineer of the New York Rapid Transit Commission has just returned from Europe, where he has been making a study of urban rapid transit. He has made a preliminary report to the Commission, with the following conclusions:—

That an underground railway operated by steam, even with the most approved system of mechanical ventilation, would be intolerable to the people of New York.

That a railway with a steady, frequent service can be operated successfully and economically by electricity.

That an underground railway operated by electricity has a comfortable atmosphere, and that it can be arranged so as to avoid great changes in temperature.

That the advice and experience of foreign engineers lean toward keeping the rail-level as close to the surface as possible, and that excavating from the surface is cheaper and safer than tunnelling, but, if conditions demand, a deep tunnel can be constructed, for which the circular form is best.

That an underground road can be so designed as to be attractive in appearance.

That the work can be carried on through a busy street without endangering the houses and without seriously impeding travel.

NOTE ON POSSIBLE REDUCTION OF STATION PLANT ON SMALL ELECTRIC RAILWAYS BY MULTIPLE SERIES CONTROL OF MOTORS.¹

BY JOHN LANGTON.

THE only efficient method of controlling electric street cars is to vary the volts at the motors according to the speed required. The facility for doing this with storage batteries, by means of grouping the batteries differently, is one of the strong points of battery traction. In a trolley or conduit system with constant line pressure the same thing is arrived at by grouping the motors in series or in multiple. With only two motors to deal with, as in an ordinary street car, this makes rather an abrupt stop, which is eased off to a more gradual change by slowing them down by a resistance in series, or speeding them up by cutting out part of the field winding or shunting it by a resistance. This method was used in the early days of electric railroads, but was abandoned, not because it failed to give the results expected, but because it introduced a new complication at a time when there were so many troubles with everything, that simplification was the pressing need. These early difficulties having been surmounted, multiple series control has been successfully revived.

The figure usually accepted for traction on street railway tracks in average condition, is 80 lbs. pull on the drawbar per ton weight of car, moving on a straight and level track. To start the car from rest requires a much greater effort. Dynamometer experiments show a starting pull of from 90 lbs. to 120 lbs. per ton, equal to the traction needed for ascending grades of 3% to $4\frac{1}{2}\%$.

When the car is started with the motors in parallel, controlled by the simple process of wasting in a rheostat the volts that are not needed at the motor terminals to give the amperes required for the traction, the demand on the station for power is greater when the car is being started than at any other time of its run, except on roads with heavy grades. But putting the motors in series for starting greatly reduces the power required. The torque of the armature, which gives the traction, is a matter of amperes, and with the motors in series the same traction is obtained with one half the current from the line required when the motors are in parallel. The power consumption from start to full speed is rather more than one half, apparently because the accelerating force is more irregularly applied, so that it takes rather longer to get up to speed; or to put the same thing another way, in order to get up to speed in the same time, rather more than half the average amperes are needed for motors in series, as compared with motors in parallel. The actual figures seem to be about two-thirds the maximum power, and two-thirds the total power consumption, in starting and getting up to speed in the same length of time. This method of starting then takes a maximum current, which if divided between the motors in parallel would only give the traction needed for ascending grades from 1% to 2%, and as almost every road has steeper grades than these, the heaviest power demand on the station comes, not from starting, but from moving up grade at full speed. But if we are content to go up such grades at a considerably reduced speed, we can get, as in starting, the necessary traction with half the amperes, by putting the motors in series. The motors are then working with good efficiency on half the line volts and running at about half speed. There is of course no saving in the total power consumption—the energy; the car takes half as much current, but also takes twice the time to cover the distance. But there is a great reduction in the maximum power required, which would be about the same on a 5% grade with motors in series as on a 2% grade with motors in parallel, or about the same as the maximum power required for starting with motors in series. The motors must carry the same current in either case and must therefore be the same size, but the maximum demand on the power station from any one car is reduced nearly one-half.

On large roads the principle of averages may be relied on to a great extent, and the station capacity per car may approximate the average power taken by the car, but on small roads it is in general only safe to provide a station capacity per car of very near the maximum car demand. On small roads, therefore, a reduction of the latter means a reduction in size of station plant. Even if the station capacity per car of large roads were appreciably affected by multiple series control it could hardly be availed of. The most valuable reduction is that on grades, which may last for some minutes whilst starting is a matter of a few seconds. But rapid transit is a principal reason of the existence of large electric roads and a prominent source of their income, and they cannot afford to go slowly up hill. For large roads the principal value of multiple series control is the ability to run slowly with good efficiency in crowded streets, and the saving of wear and tear on switch and rheostat at such times and at starting. On small roads with a few cars running on fifteen to twenty minutes headway it is more a question of communication than of continuously rapid transit; and, as has been shown, by sacrificing speed up hill a substantial reduction in the first cost of power plant may be achieved, without any sacrifice of ability to run at

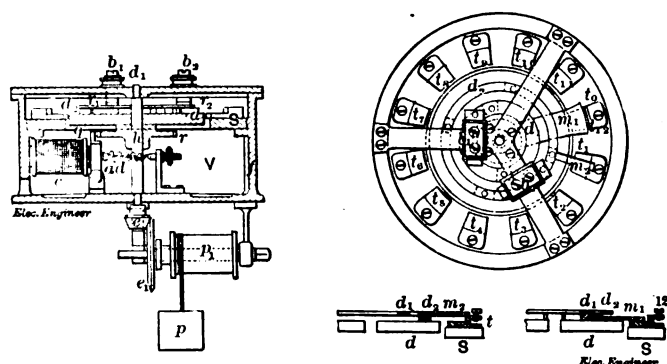
¹ A paper read before the Canadian Electrical Association.

high speed on the level and low grades. The horse power hours drawn from the station would be the same per car trip in either case, but by easing off the starting current and slowing up on grades, the power would be drawn more uniformly, with the tendency to reduce the variations of load on the steam engines. This should give better economy in steam consumption, but it is not at all probable that there would be any noticeable effect on the coal bill. The load diagram of the station would still be badly serrated but the peaks of the diagram would be of more uniform height, and the highest of them lower than with motors always in parallel.

There is nothing new in this paper, and the facts and conclusions seem fairly obvious, but similar simple engineering considerations are continually either not observed or not appreciated in projected works, with the result of paying an extravagant price for some quality which brings in an inadequate or no return.

THE CLARET-WUILLEMIER SYSTEM OF ELECTRIC TRACTION AT LYONS, FRANCE.¹

FOR some months past an electric tramway on a system possessing some curious features has been working without a hitch at Lyons in connection with the Exhibition now being held there. The



FIGS. 1, 2, 3, 4, 5 AND 6.—THE CLARET-WUILLEMIER SYSTEM OF ELECTRIC TRACTION AT LYONS, FRANCE.

line is double track, one-metre gauge, some two miles long, and it runs from the centre of the town to the Exhibition gates. The generating plant is inside the Exhibition grounds, and comprises a 100-H.P. gas-engine, belted to a six-pole 500 volt Thury dynamo; the gas is manufactured on the spot by the Buires-Lancauchez process. The rolling stock comprises 12 motor-cars, each weighing, with its complement of 42 passengers, and its 20-H.P. double-reduction Thury motor, something like nine tons. The speed is regulated by switching resistances into and out of circuit. Carbon brushes are used, the wear of which, it is said, amounts to 0.06 mm. per run of 100 kilometres. During the month of August the line was used by 124,000 passengers; 15,000 being the largest number carried as yet in one day.

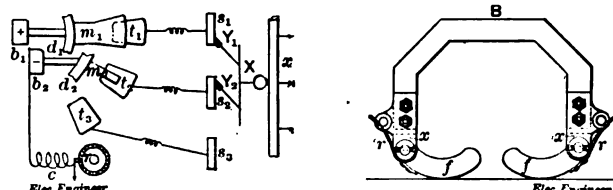
The Claret-Wuillemier system is a special application of the principle of bringing successively into contact with the live conductor sections of an insulated conductor laid between the rails on a level with the roadway. The sectional conductor consists of reversed rails 2.8 metres long and 3 metres apart; so that the cars, which are 7.6 metres long, almost cover two sections and an intervening gap. The sections are insulated by wood paving blocks run in bitumen. The main cable, which has a section area of 0.135 sq. in., and is armored and lead-covered, is run under the pavement, the feeding wires from the distributors being led to the sectional conductor inside a wooden trough impregnated with a preservative and tarred. The return is by the rails.

The distributors, which are laid in pits 100 metres apart, are as follows: In each distributor there is a spindle h , Fig. 1, carrying a ratchet wheel, r , upon which rests an insulating base, d , which supports two copper rings, d_1 and d_2 , insulated from each other. Ring d_1 carries the horizontal arm m_1 , Fig. 2, and ring d_2 the arm m_2 ; so that as h revolves these two arms come into contact with the contact-pieces t_1 , t_2 , etc. The arm m_1 is somewhat wider than the interval between two contact pieces, m_2 being narrower than this interval. In Figs. 3 and 4 we see that the arm m_1 presses on the upper edge of the contact pieces, whilst m_2 presses only on the lower part. Each contact piece is, however, all in one part, except in one instance, where the two portions are insulated from each other, as shown in Fig. 4. From each of the contact pieces wires run to the corresponding sectional conductor. The rings d_1 and d_2 are placed in connection with the terminals b_1 and b_2 , respectively, Fig. 1, by means of brushes, b_1 being in connection with the main conductor, and b_2 with one end of the coil of the electromagnet c , Fig. 1, the other end of which is to earth. The rotation of the

arms m_1 and m_2 is effected by means of a weight (or electric motor) p , which communicates motion by the bevel wheels e and e_1 , Fig. 1, to the spindle h , the ratchet wheel r of which cannot rotate, however, until a stud, q , on the armature of the electro-magnet c releases it.

The diagram, Fig. 5, shows what happens as a given car, x , passes along. As shown, the rear collector y_1 of the car is just leaving the sectional conductor s_1 , and the front brush y_2 has just come into contact with the section s_2 . The current from the dynamo reaches the distributor by the terminal b_1 , passes to the copper ring d_1 , along the arm m_1 to the contact piece t_1 , thence to the sectional conductor s_1 , along the collector y_1 , to the car-motor, and thence by the wheels to the rails x and back to the dynamo. But a portion of the current finds its way back *via* collector y_2 , sectional rail s_2 , contact piece t_2 , arm m_2 , ring d_2 , terminal b_2 , and electro-magnet c . This current causes the electro-magnet to attract its armature and to release the ratchet-wheel r , so that the weight p immediately comes into action, and revolves by the ratchet-wheel the amount of one tooth, switching m_1 on to t_2 , and m_2 on to t_1 , when the whole of the motor current is collected by y_2 ; and the electro-magnet, being cut out of circuit until y_2 comes into contact with s_3 , ceases to attract its armature and allows the stop q to arrest the motion of the ratchet-wheel r , and so on, until the car has passed to the last sectional rail connected to the particular distributor. To this last section is also joined up the first contact piece of the next distributor, which is thus enabled to take up the running.

On looking at Fig. 4 it will be observed that the lower part of the last contact-piece, on which presses the arm m_2 , conveying the main current, is insulated from the rest, so that when the car leaves the last sectional rail connected to the distributor under consideration, it leaves the distributor insulated, and the car has



to take all its current from the next distributor, and, no current finding its way home *via* the electro-magnet c , the distributor remains at rest until the front collector of the next car comes on to sectional conductor s_1 when the cycle of operations begins once more.

A distributor of this kind, it is obvious, is only applicable to a double-track line; that is, to one on which the cars are always travelling in the same direction along the same individual track. It will also be obvious that the use of distributors results in a perfect block-system, the cars being perforce kept apart by at least the length of the portion of the sectional conductor served by one distributor. To apply the distributor to a single track line, with cars running in either direction, several additional complications are needed, for a detailed description of which we must refer our readers to *L'Electricien* for September 22, whence these particulars and some of the illustrations are taken.

In Fig. 6 we have a side view of the collectors used at Lyons, each of which is composed of three pairs of shoes, each car having four sets altogether, two being at the rear and two at the front of the car. The part a is a permanent magnet, f being cast-iron pole-shoes capable of revolving round x , rr being springs which lift the collecting-shoes off the roadway when they are not pulled down by the attraction of the iron sectional conductor.

PERSONAL.

MR. ALEXANDER J. WURTS has been awarded the John Scott premium and medal by the Franklin Institute in recognition of his inventions in lightning arresters for lightning and power circuits.

MR. HANS ZOPKE, royal engineer, connected with the Russian railway system, is in this country for the purpose of examining into American railway systems and methods. He has completed an inspection of the elevated and surface railroads in this city.

HON. JAMES D. REID, U. S. Consul at Dunfermline, Scotland, is at present in this city, and will make a Western trip before returning to his post. His hosts of telegraphic friends will be glad to know that he is in good health and as blithe as ever.

THE ELECTRICAL ENGINEER.

[INCORPORATED]

PUBLISHED EVERY WEDNESDAY AT

203 Broadway, New York.

Telephone: 1323 Cortlandt.

Cable Address: LENGINEER.

Geo. M. Phelps, President.

F. R. COLVIN, Treas. and Business Manager.

Edited by

T. COMMERFORD MARTIN and JOSEPH WETZLER.

Associate Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue, Boston, Mass.

Western Editor and Manager, C. KAMMEYER, 1439 Monadnock Building, Chicago, Ill.

New York Representative, 208 Broadway, W. F. HANKS.
Philadelphia Representative, 916 Betz Building,

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada, - - - - -	per annum, \$3.00
Four or more Copies, in Clubs (each) - - - - -	2.50
Great Britain and other Foreign Countries within the Postal Union " - - - - -	5.00
Single Copies, - - - - -	.10

[Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1898.]

EDITORIAL ANNOUNCEMENTS.

Addresses.—Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of THE ELECTRICAL ENGINEER. Communications for the attention of the editors should be addressed, EDITOR OF THE ELECTRICAL ENGINEER, 203 Broadway, New York City.

VOL. XVIII. NEW YORK, OCTOBER 17, 1894.

No. 337.

CONTENTS.

EDITORIALS:—

Mechanical vs. Electrical Accumulators in Railway Work.....	PAGE. 314
The National School of Electricity.....	315
Steam Railroad Opinion on the Trolley.....	315
Electric Railway Expenses.....	315

ARTICLES:—

The Riker Storage Launch Operated from Trolley Circuit at Stamford, Conn. (illustr.).....	305
Electrical Machinist Practice.—V. (illustr.).....	J. F. HOBART. 306
Magnetic Leakage in Dynamo-Electric Machinery.—VI. (illustr.).....	A. E. WIENER. 307
The Antwerp Trolley Balloon (illustr.).....	309
A Few Figures on Electric Railway Expenses of Operation.....	310
Long Electric Roads in Maryland and Pennsylvania. (illustr.).....	311
Note on Possible Reduction of Station Plant on Small Electric Railways by Multiple Series Control of Motors.....	JOHN LANGTON. 312
The Claret-Wuillemier System of Electric Traction at Lyons, France (illustr.).....	313
National School of Electricity.....	313
Opinions of Steam Railway Managers on Trolley Competition.....	319

NEWS AND NOTES:—

The Toronto Lighting Contract.....	312
A Report from Rapid Transit Engineer Parsons.....	312
A Decennial Issue.....	320
Ottawa Electric System.....	320

PERSONAL:—

Mr. A. J. Wurts.....	318
Mr. Hans Zopke.....	313
Hon. J. D. Reid.....	313

LEGAL NOTES:—

Preliminary Injunction Granted—Accumulator Co. vs. Edison Electric Illuminating Co. of New York.....	316
The Telegraph in the U. S. Supreme Court.....	316

LITERATURE:—

"Sixth Year Book of the Brooklyn Institute of Arts and Sciences".....	316
Hawkins' "Aids to Engineer's Examinations".....	316
"Practical Notes on Rope Driving".....	316

SOCIETY AND CLUB NOTES:—

American Institute of Electrical Engineers.....	317
A Trip to Riker's Island by the New York Electrical Society (illustr.).....	317

LETTERS TO THE EDITOR:—

The Monocyclic as Distinguished from the Polyphase System (illustr.).....	C. P. STEINMETZ. 317
A Statement from the Electric Storage Battery Co.....	W. W. GIBBS. 318

OBITUARY:—

Mr. George M. Phelps, Sr.....	320
-------------------------------	-----

TRADE NOTES AND NOVELTIES AND MECHANICAL DEPARTMENT:—

The Thomson '93 Alternating Arc Lamp (illustr.)—Anderson Trolley Line Apparatus (illustr.).....	321
The Jewell Trolley Sling (illustr.)—The General Electric Co. at the Atlanta Convention.—The Reliance Electrical Apparatus.—The Fletcher Rapid Transit Switch (illustr.).....	322
The Keystone "Type K" Instrument (illustr.)—Electric Selectors on the B. & O.—Bliss Friction Clutches.....	323
How to use Micanite.—The Bryant Chandelier Switch (illustr.)—W. S. Hill Electric Co.'s Heavy Current Switches (illustr.)—Investigation of Industrial Changes.—Western Notes.....	324

MECHANICAL vs. ELECTRICAL ACCUMULATORS IN RAILWAY WORK.

NO engineer who has watched the fitful play of the ammeter indicators in railway power stations can have failed to be impressed with the effect on engine economy which the variations in load thus indicated must exert. It is not too much to say that the losses due to this cause are greater than those of all others combined, and hence it is of paramount importance to inquire into the methods which may grant relief, especially for small roads. Falling back upon the experience gained in electric lighting in providing for heavy loads by means of an auxiliary storage battery, the electrical engineer naturally turns to this remedy, as his first choice. The first road equipped on this system, that running from Zurich to Hirslanden, Switzerland, has a normal generator capacity of 120 amperes at 550 volts and utilizes storage batteries which take care of fluctuations varying between zero and 200 amperes. It is evident that with such an installation the size and cost of steam plant, independent of the higher economy obtained is considerably smaller than would be required where the current is derived entirely from engine driven generators. Another instance is that afforded by the Douglas & Laxey road in the Isle of Man, engineered by Dr. E. Hopkinson, where a midway storage station of 240 cells is usually connected in parallel with the two generating stations one at each end of the line. The plant charges or discharges according to the requirements of the traffic, and is brought up to full charge at any time by means of a motor generator placed in one corner of the storage battery house. Not only does this battery throw in its welcome reserve of current when an extra drain occurs, but it has a special function in winter. During that season, the road, which is chiefly dependent on tourist traffic, is required by law to run two cars each way daily as a minimum. In order to carry out this requirement, the battery is charged up once a week and then takes care of the whole road, so that the power houses are completely shut up the rest of the time. As the battery will discharge 70 amperes for 9 hours, and as the road is not seven miles long, it will be seen that the light and almost non-existent winter travel can be very comfortably taken care of by the auxiliary storage plant.

We are glad to note therefore that a similar storage battery plant is to be installed in connection with the electric railway at Merrill, Wis., as we believe that it will be the forerunner of numerous others. But in considering the problem of storing energy ready to be drawn on instantly, one must not lose sight of the old mechanical-energy storer, the fly wheel. In his recent admirable paper on "Electric Railways," Dr. Edward Hopkinson remarks that if an efficient accumulator capable of working as a regulator, could be introduced, it would be possible to reduce the capacity of a generator plant by at least 35 to 40 per cent. and at the same time considerably increase its efficiency. Such an accumulator, he ventured to suggest, could be found in better wheel construction. The idea here brought forward forms the subject of a paper read by Mr. John Galt, C. E., before the Canadian Electrical Association, in which the author devotes considerable attention to the construction of flywheels

to withstand the work, and describing Prof. Sharps bicycle wheel construction. There are thus offered two methods of overcoming the evil effects of load fluctuation in railway work. Assuming that the mechanical difficulties encountered in the construction of high speed heavy flywheels can be overcome, there are other considerations which would enter into the choice as between mechanical and electrical accumulators. Principal among these is the fact that no flywheel of practical size can take care of a prolonged overload, and when such a condition does arise, the flywheel becomes a most serious drawback. While it is true that the usual periods of fluctuation above the normal, in power stations, do not exceed a minute, and are usually less, there are times when this period is considerably increased, and then the flywheel, as stated, may actually become a drag, preventing the engine from recovering its speed. No such difficulty would present itself in the case of the storage battery, which in a pinch might even take the entire load of the station for a short while. The electrical accumulator method certainly permits of a flexibility which cannot be obtained by the other method, and to that extent at least is therefore superior to it.

THE NATIONAL SCHOOL OF ELECTRICITY.

WE have had so many inquiries of late on the subject of the National School of Electricity that we are glad to be able to print in this issue a statement from Dr. J. A. Hornsby as to what it is actually accomplishing. There seems to be some misapprehension in the public mind as to the scope and aim of the School and as to its possibilities. It should be clearly understood that it is not a philanthropic enterprise but a commercial one, just like a business college, and that it is organized on a stock basis. In other words it exists to make money out of tuition fees. This is entirely right and proper, but places it at once on a different basis from Cooper Union or the University of Chicago, or Columbia College; and we think that the distinction should be well marked and known.

Another point it is proper to touch on is the fact that the pupils, while greatly helped along, cannot be made into electrical engineers by any such schools or methods. It is a question whether the instruction can be definite enough to qualify its recipient for even a dynamo tender's job, the difficulties being very much the same as those which have attended the schools of telegraphy, whose reputation is to-day so bad and toward which practical operators entertain so strong a feeling of detestation. The very fact that the instruction is directed from a central point, on a wholesale plan, deprives it also of the close scrutiny of individual work that is even possible with carefully conducted correspondence schools, such as that carried on by a well-known electrician in Cleveland, Prof. Roberts.

In other words, the sphere of such schools of electricity narrows down to giving better ideas on the new subject to the class throughout the community that has an uneasy feeling that it would like to know and ought to know more about it. Prof. Crocker had just such a class of professional men at Columbia two or three years ago, and it is probable that those lawyers, doctors, litterateurs and merchants went back to their regular duties all the better for having an intelligent grasp of electrical principles. Out of such material, on a lower plane, the

National School of Electricity should be able to establish a great many classes, and the work will be in every way laudable, while it ought to be profitable to the management. But we do hope that in every case the instructors will be careful not to let their enthusiastic but hardly overrich students, start in with the idea that when they get through, fat positions await them as fullfledged engineers.

In one respect the school would strengthen itself we think by dropping from its announcements the names of Mr. Edison and Mr. Tesla, neither of whom has any share in its work, and whose place in the Faculty is therefore misleading. The other men are good enough for all the practical purposes of the School, and should have the credit of whatever success attends it. The names of such men as Prof. Anthony and Prof. Jackson need no bush, and all can rest easy in the conviction that the endeavor of educators of that stamp will always be in the right direction. The movement is too important to be allowed to go wrong, and our remarks are proffered altogether in the hope and with the wish that the School may do lasting good in more than one community.

STEAM RAILROAD OPINION ON THE TROLLEY.

It is not to be supposed that the new trolley competition with the steam railroads for short travel is the subject in electrical and street railway circles only. At any rate, we are able to print in this issue a number of opinions from leading managers of steam railroads, from which it will be gathered that their alert minds are already engaged with the new questions. In some instances, perhaps, the apprehension of new trouble is keener than in others, but it is evident that throughout there is no intention or desire to choke off this rather unexpected species of competition. To do that would be to repeat the folly of some of the gas plant managers in the early days of electric lighting, before they had recognized its limitations, or realized that it was better as a friend than as foe. Just how the new railway problems will be met we do not know, but one way out is for the steam railroads to work with the trolley instead of attempting to oppose them. So, too, the trolley companies must come to admit the fact that steam railroads have rights if only as important servitors of the public.

ELECTRIC RAILWAY EXPENSES.

As opportune to the current convention of the American Street Railway Association, we have thrown together a variety of statistics bearing upon the cost of trolley railway operation and maintenance, supplemented by like figures for elevated roads operated by electricity or steam. There is also a small table contrasting trolley with cable. While it will be seen from these tables that trolley expenses are higher than they were set forth a few years ago, as for example in what are known as the Badger tables, they are still very favorable to trolley operation; while the showing for elevated electric roads is remarkably good, especially in view of the fact that relatively small travel is contrasted with large. The London underground electric figures are also good. We shall be glad when the day arrives that will see similar detailed statistics available from successful storage battery and open or closed conduit roads. Meantime, taking trolley figures as they stand, it is evident that the heavy items for removal of ice would be largely omitted if there were no overhead wires to bother with. Our Southern friends are to be envied their immunity on this score.

LEGAL NOTES.

A PRELIMINARY INJUNCTION GRANTED.

THE ACCUMULATOR COMPANY vs. THE EDISON ELECTRIC ILLUMINATING COMPANY OF NEW YORK, IMPEADED WITH THE ELECTRIC STORAGE CHLORIDE BATTERY COMPANY.

ON Oct. 8 Judge Lacombe of the U. S. Circuit Court for the Southern District of New York, handed down a decision, granting a preliminary injunction asked for by the Accumulator Co. We give the decision in full, below :

The Battery Company, which is named as a defendant, but which, being a non-resident has not been served, and does not appear, manufactures the articles alleged to infringe. The Illuminating Company has contracted to purchase a large number of them and is about to put them to use in this city. Complainant is the owner of Letters Patent, Reissue No. 11047, December 17, 1889, original No. 812599, February 17, 1885, to J. W. Swan for "Secondary Battery" a variety of electric storage battery. The original patent No. 812599 was considered by this court in *Accumulator vs. Julien Co.*, 38 Fed. Rep. 117, and held invalid, as it described and claimed more than the inventor discovered. Thereupon the reissue was obtained and said reissue was considered by this court and sustained in *Accumulator vs. N. Y. & Harlem R. R. Co.* 50 Fed. Rep. 81, opinion by Judge Coxe. In an application therefor for preliminary injunction on the same patent the construction laid down in that opinion will be adhered to.

The claim of the patent is for :

"A perforated or cellular plate for secondary batteries, having the perforations or cells extending through the plate and the active material or material to become active packed in the said perforations or cells only, substantially as described."

Judge Coxe held that although the art already showed plates in which the active material was packed into grooves or holes not extending through the plate, and also plates where the active material filled not only the perforations, but also the entire surface of the plate itself, Swan's combination in which the perforations extended through the plate and the material filled the perforations only was original with him. That it was not only new but useful, an important advance in the art, and that "the idea which has made these plates a commercial success was first given to the world in a practical embodiment by Mr. Swan." No new evidence tending to modify Judge Coxe's opinion being introduced it settles the law of this case, and the only question here is whether defendant's plates infringe.

These plates, which are for secondary batteries, are perforated plates, the perforations extend through the plate, the active material is found in the said perforations and in them only. Infringement by the completed structure is so plain, that defendant has been constrained to insist that Swan's patent is practically for a process and therefore, as defendant's process of making the plates is a different one there is no infringement. Thus Swan constructed a plate with perforations or cells extending through it and then packed the material in the perforations; defendants arrange pastels or buttons of the material in a mould and then cast the plate around them. Manifestly the result is the same whether the material is packed within the bounding walls of the perforations, or whether the bounding walls of perforations are packed around the material. Defendants also insist that the material which they use is not active when the process of packing antimonious lead around it is complete and that it does not become active the moment it is placed in the battery fluid, but requires further electrolytic treatment before it becomes active. But the patent is not confined to active material, it includes "material to become active," and whether it becomes active by one process or another is apparently immaterial. The gist of Swan's invention, as found by Judge Coxe, was the confining of the material which was to do the work within perforations which extended completely through the plate. The advantages of such plates is pointed out in his opinion, and those which defendant threatens to use are plainly such plates. There is nothing in the patent or in Judge Coxe's opinion which supports the contention that the claim is other than what it appears to be—a claim for a completed article, not for a process of manufacture. Infringement is clear.

It is further contended on behalf of the defendant that complainant has been guilty of such laches as should preclude the granting of a preliminary injunction. In a case where this defendant, or its allied corporation was complainant, the Court of Appeals in this circuit held that the owner of a patent was under no obligation to sue every infringer forthwith upon discovery of the infringement, provided he proceeded with due diligence against the one whom he did sue. *Edison Electric Light Co. et al vs. Sawyer-Man Electric Co.*, 3 C.C.A. 605. There is no suggestion of any unreasonable delay in prosecuting the test suits against the Julien Co. and the N. Y. & Harlem R. R. Co. Judge Coxe's decree in the last named suit is dated April 13, 1892. The present action was begun in August 1894. During the intermediate period and for some years before, certainly since 1889, the Storage Battery Company made plates which differed from those sold to the Illuminating

Company, both in the size of the plate and in the size of the buttons. The plate now complained of is 15 inches square, and contains 256 buttons of active material; the older plates were 6 by 8 inches and contained 9 or 12 buttons. Both were equally infringements of the patent, which is not confined to plates or buttons of any particular, absolute or relative size. Complainant insists that it did not prosecute for infringement by the earlier plates, for the reason that it did not believe them to be commercially harmful. The grounds for that belief are said to be the relative size of plate and button. In the latter plates the loss by accident, while in use, of the contents of a single hole would not, it is asserted, practically destroy the usefulness of the plate, being only a loss of $\frac{1}{16}$ of the active material. A similar accident to the older plate however would destroy its usefulness, as a single perforation holds $\frac{1}{4}$ or $\frac{1}{2}$ of the active material. This explanation seems a reasonable excuse for failing to prosecute against the older plates and I find nothing in the transactions between the complainant's officers and those of the Storage Battery Co. which should estop complainant from maintaining this action. In April, 1893, certainly, both sides understood and expressed their understanding in writing that the question of infringement of the several patents owned by complainant would be tested by suit.

As to the Danish patent, the conclusion reached by Judge Coxe without argument, viz., that "it is not for the same invention as the Swan reissue" is concurred in by this court, after argument.

Motion for preliminary injunction granted.

Judge Lacombe of the U. S. Circuit Court, on Oct. 10 denied the motion of the Edison Electric Illuminating Company to suspend, pending appeal, the injunction granted by him against the use of the Chloride battery.

THE TELEGRAPH IN THE U. S. SUPREME COURT.

As is usually the case, many of the suits in which the Government is interested are advanced for hearing early in the term. This year special interest attaches to these cases from the fact that two are to be argued involving the Sherman Anti-Trust act and one the Anderson act, directed against the Western Union Telegraph Company and the railroads subsidized by the United States. These cases are set for the second Monday of the term.

The case of the Government against the Union Pacific Railway Company and the Western Union Telegraph Company is a suit to cancel the contracts made between the railroad companies and the Western Union Telegraph Company, on the ground that they are in restraint of trade and commerce. This test case was decided by Justice Brewer on the circuit in favor of the Government, but was reversed by the Circuit Court of Appeals at St. Louis. The decision of the Supreme Court will probably settle the rights of the Government and of the railroad and telegraph companies.

LITERATURE.

Sixth Year Book of the Brooklyn Institute of Arts and Sciences Brooklyn, 1894.

This annual contains the record of the work done by the twenty-five departments of the Institute. The electrical work of the past year included lectures on a variety of electrical topics. Lectures for the coming season will be held in a lecture hall fitted out specially for the purpose and tendered to the Institute by the Edison Electric Illuminating Co. of Brooklyn.

Aids to Engineers' Examinations. By N. Hawkins, M. E. New York, 1894. Theo. Audel & Co. 206 pp. 5 x 7 in. Leather. Price, \$3.

This work is a summary of the principles and practice of steam engineering specially intended for applicants of all grades in steam engineering service both stationary and marine. The information is imparted in the form of the catechism by question and answer. We also find the U. S. Government rules for marine engines, and various information useful to the engineer as well as the owner of a steam engine plant. The book is handsomely bound and printed on heavy paper with gilt edges.

Practical Notes on Rope Driving. By M. E. New York, 1893. The Street Railway Publishing Co. 48 pp. 5½ x 9 in. Paper. Price, 50 cents.

While the electric motor is the medium par excellence for power transmission, the electrical engineer ought to be fully acquainted with other methods, which it may at times be found advisable to adopt in certain situations. Rope driving is one of the oldest methods of transmission and is still in use to no inconsiderable extent, more particularly abroad. The author has given a very concise account of the experience gained with the method and the rules for construction which have been found to give the best results in practice.

SOCIETY AND CLUB NOTES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

THE 90th meeting of the Institute will be held at Headquarters, 13 West Thirty-first street, New York City, on Wednesday, Oct. 17th, at 8 P. M. A paper will be presented by Lieut. Samuel Reber, of Fort Riley, Kan., recently of Johns Hopkins University, Baltimore, on the "Theory of Two and Three-Phase Motors." Also a paper by Mr. Charles P. Steinmetz, of the General Electric Co., Schenectady, N. Y., on the "Theory of the Synchronous Motor."

A meeting of Western members will be held on the same evening, Oct. 17th, at 8 P. M., at Armour Institute, Thirty-third street and Armour avenue, Chicago, where the above papers will be read by Prof. W. M. Stine.

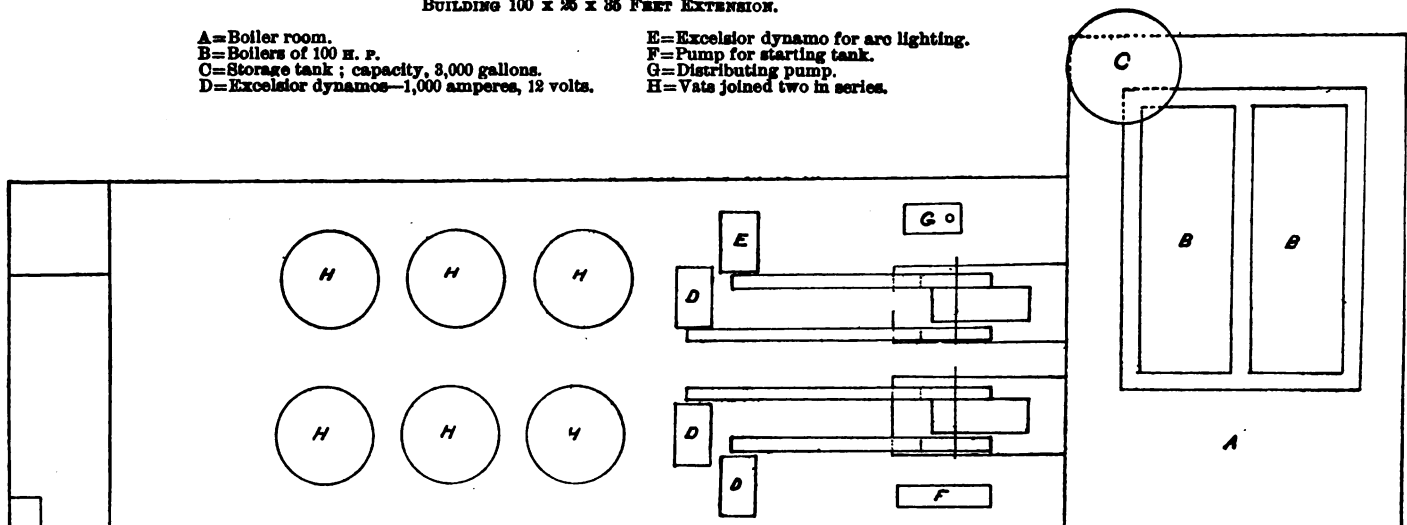
A TRIP TO RIKER'S ISLAND BY THE N. Y. ELECTRICAL SOCIETY.

THE work being done by the Woolf electrozone process of disinfection has attracted so much attention that the New York Electrical Society carrying out its customary and praiseworthy idea of seeing things for itself, organized through secretary Guy an excursion to Riker's Island on Thursday afternoon last, when more than 75 members mustered on board a steamboat provided for the occasion. Arrived at the Island, an inspection was made of the many acres of New York garbage there dumped and recently rendered innocuous by electrozone; and after that a visit was made to the permanent plant just finished for the purpose of disinfecting all further garbage arrivals (a complete article on the general subject with many illustrations appeared in THE ELECTRICAL ENGINEER of August 8, 1894, No. 827, page 101 et seq.) At the outset of the work, the electrozone-making plant was on a barge; the new station is on the Island, solidly built of wood, and contains boilers of 100 h. p.; engines to correspond; three Excelsior plating dynamos for electrolyzing the vats; one Excelsior arc machine for lighting; pumps for distributing the liquid through the vats and the mains over the Island; and six large vats. The dynamos deliver a current of about 1,000 amperes each at 12 volts, and the output of the plant at present is about 12,000 gallons per hour of electrozone. The water is pumped up from the Sound and passes directly into use after being converted into electrozone by means of the current. Each vat has in it a zinc-platinum electrolyzing couple consisting of 5 zincs and 4 platins; the former being 12 by 12 inches and an inch thick, and the platins being 13 by 15 inches having a copper core covered by platinum .008 inch thick. The

BUILDING 100 x 25 x 35 FEET EXTENSION.

A=Boiler room.
B=Boilers of 100 h. p.
C=Storage tank; capacity, 3,000 gallons.
D=Excelsior dynamos—1,000 amperes, 12 volts.

E=Excelsior dynamo for arc lighting.
F=Pump for starting tank.
G=Distributing pump.
H=Vats joined two in series.



PLAN OF PERMANENT WOOLF ELECTROZONE PLANT AT RIKER'S ISLAND.

zincs weigh 40 pounds. The wear of the elements is insignificant. The new plant is in full running order. By invitation of President C. O. Mailloux, an address was delivered off hand on the subject by Mr. A. E. Woolf, who answered very fully a great many pertinent questions. Street Cleaning Commissioner Andrews, who was present, made also an admirable little address, in which he spoke of his hope that at no distant date similar plants on a smaller scale might be located at each of 17 points in New York where the garbage is collected, and that both carts and streets might get an occasional washing down with electrozone, of whose merits he had formed a high opinion. Some of the doctors present evinced great interest in the application of electrozone to various diseases, including diphtheria, typhoid and cholera; other members inquired as to bleaching work; and

altogether the inspection and discussion were replete with interest and instruction. It may be noted, too, that the Island is now completely subjugated and inoffensive. The members of the Society returned home deeply impressed with what they had seen, satisfied that a great future awaits the process of electrolyzing sea or salt water for all purposes of sanitation, and that new opportunities are open for electricity in this field.

LETTERS TO THE EDITOR.

THE MONOCYCLIC AS DISTINGUISHED FROM THE POLYPHASE SYSTEM.

In your issue of October 10, I notice an inquiry regarding the monocyclic system. While in general I do not care to take any notice of anonymous communications, in this particular case I may be excused in correcting a few mistakes, having myself taken an important part in originating the monocyclic system.

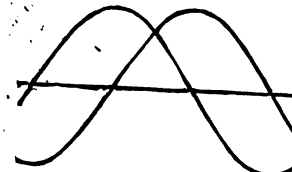


FIG. 1.

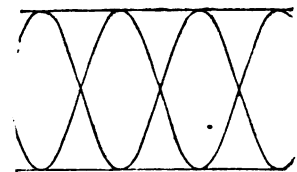


FIG. 2.

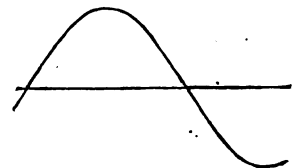


FIG. 3.

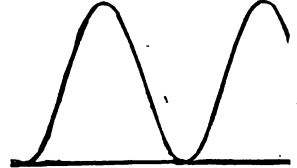


FIG. 4.

Leaving aside all theoretical considerations, as, for instance, the representation of the action of a polyphase induction motor by the hypothesis of the rotating field, I shall deal only with what really takes place in the system.

In Fig. 1 are shown the two current waves of a quarter phase system. Fig. 2 gives the energy waves of these two currents. As will be seen, the total instantaneous flow of energy is constant

throughout in the quarter phase system. The same holds for any polyphase system. In the single phase system, however, as in the monocyclic system, the flow of current issuing from the generator is represented by Fig. 3. The power wire in the monocyclic system carries no current, or an idle or wattless current only. Thus the wave of energy is as represented in Fig. 4,—pulsating.

This constancy on the one hand, and pulsating nature on the other hand, of the wave of energy, forms the distinguishing feature between the polyphase system and the single phase system, and classifies the monocyclic system as a single phase system.

CHAS. P. STEINMETZ.

SCHENECTADY, N. Y.

A STATEMENT FROM THE ELECTRIC STORAGE BATTERY CO.

In view of the publicity given to Judge Lacombe's recent decision in the case of *The Accumulator Company vs. The Edison Electric Illuminating Company of New York City* directed against our Chloride accumulator and based upon the Swan Reissued Letters Patent which expires May 24, 1895, we deem a statement of facts necessary that our customers and the public generally may not be deceived or tricked into withholding orders from us through fear of litigation, or into buying the batteries of *The Accumulator Company* and the *Consolidated Electric Storage Company* in the belief that they cannot procure and use, with perfect safety, our Chloride accumulators which we are manufacturing and selling under an absolute guaranty to protect and save harmless all users.

This company has not been enjoined from either manufacturing, selling or using its well known Chloride accumulators, nor has any one been enjoined from purchasing or using them. The Edison Electric Illuminating Company of New York has been enjoined by Judge Lacombe from installing our Chloride accumulators as a part of its central station plant simply to maintain the *status quo* pending the hearing and determination of the case in the Circuit Court of Appeals, upon the contention that the Edison Electric Illuminating Company, having simply contracted for our accumulators and not yet actually installed them, should not be permitted to do so until the questions involved in the litigation should be finally determined in the United States Circuit Court of Appeals, especially as an appeal could be at once taken to and heard in that court on the 80th of October and an early decision had thereon; and that was the view taken by Judge Lacombe and upon which he acted.

Judge Lacombe's injunction has no other effect or significance and in no way affects this Company's business of manufacturing and selling Chloride Accumulators, or of their use by purchasers, and was conditioned upon the Accumulator Company giving to the Edison Electric Illuminating Company, of New York, a bond in the sum of \$20,000 to make good any loss which it should sustain resulting from the delay in installing our accumulators should the decision of the Circuit Court of Appeals be in favor of the Edison Company, which we are advised and believe will be the certain result of our appeal to that effect.

We are advised by our counsel and experts, among them Professor Charles F. Chandler, of the School of Mines, Columbia College; Professor George F. Barker, of the University of Pennsylvania; Professor Edwin J. Houston, President of the American Institute of Electrical Engineers, and Professor Arthur E. Kennelly, of the Medico-Chirurgical College, of Philadelphia, that our Chloride accumulator is not an infringement of any letters patent owned by either the Accumulator Company or the Consolidated Electric Storage Company, and that in their opinion the Swan Reissued Letters Patent are invalid and expired with the expiration of the Swan Danish patent in 1888; defences which could not be availed of by us in opposition to the motion for preliminary injunction before Judge Lacombe, they having been previously passed upon by Judge Coxe in a former decision in the same court in the case of the Accumulator Company vs. The New York and Harlem Railroad Company for the use of the so-called Julien battery,—which battery was made in exact accordance with the plate of the Swan Reissued Letters Patent, and in which our Chloride battery was not involved. Judge Lacombe held that on a motion for a preliminary injunction Judge Coxe's opinion was controlling and must prevail until the consideration of the case in the Circuit Court of Appeals, when those defenses would be fully heard and determined for the first time, as in the case where Judge Coxe sustained the Swan Reissued Letters Patent no appeal was taken, an agreement having been made between the Consolidated Electric Storage Company, who was defending that case, and the Accumulator Company shortly after that decision.

The facts are these, from which any intelligent reader can draw his own conclusion:

In December 1890, the Accumulator Company brought suit against us in the United States Circuit Court for the District of New Jersey, in which we appeared and made answer and thereafter and down to the Fall of 1893 no attempt was made to press the case, when it was finally abandoned owing to our positively declining to further extend the time and demanding that the case proceed to trial. The Swan Reissued Letters Patent, upon which alone Judge Lacombe's injunction is based, was at that time owned by the Accumulator Company, although they did not include it in that suit nor did they, after abandoning the suit, make any claim against our plate until August last, when the Edison Electric Illuminating Company of New York selected our battery for Central Station use in preference to any other battery in the world. Then, instead of bringing suit against us they brought suit in New York against the Edison Electric Illuminating Company, and applied for an injunction to force a temporary delay in the installation of a battery under our contract with that Company. The work of preparing for the installation is going on and will be completed in time to install the battery upon

the decision of the Circuit Court of Appeals, which we are confident will be favorable to us, and may be expected early in November. Swan's United States patent was applied for January 18, 1882 and was based upon an English patent to Swan of May 24, 1881, which expires May 24th 1895, at which time the United States Letters Patent will also expire,—so this much talked-of suit is based upon a patent which will expire in about seven months, and obviously was brought for no other purpose than annoyance.

There is no occasion for anyone to be annoyed or intimidated by threats of litigation for we shall continue to manufacture the Chloride accumulators and furnish them under an absolute guaranty to all who require the best battery for all purposes now manufactured, and when *The Accumulator Company* wants to enjoin us, they will have no difficulty in finding us, no more so than did the Consolidated Electric Storage Company who brought a suit against this Company in January last in the United States Circuit Court for the District of New Jersey accompanied with a motion for injunction, which, after full preparation, was heard at great length before Judge Green, and resulted in an opinion denying the motion for injunction—which opinion speaks for itself, having heretofore been published in the columns of this journal. Since then that suit has been dismissed.

We are ready at all times to fight out any supposed charge of infringement that either the Accumulator Company or the Consolidated Electric Storage Company think they have against us, but we object to their proceeding against our customers, which obviously is for the sole purpose of annoyance and intimidation—methods which reputable business men would not countenance. Let them proceed directly against us, when, if they get an injunction, it will be of some value to them and the public will not be annoyed. All suits which they have heretofore brought against this Company have been abandoned.

We say to our customers, and those contemplating the purchase of storage batteries, not to be intimidated or influenced by any threats of litigation, or any such public announcements as have been made based upon the above-explained decision of Judge Lacombe, as this Company will stand between its customers and these attacks.

ELECTRIC STORAGE BATTERY CO.

By W. W. GIBBS, Pres't.

PHILADELPHIA, Pa., Oct. 11th, 1894.

THE NATIONAL SCHOOL OF ELECTRICITY.

We are indebted to Dr. J. Allan Hornaby, Secretary of the School, for the subjoined interesting report of progress:—

The National School of Electricity has just established headquarters in New York City at the Decker Building, Union Square. Classes will be organized at several points in the city, as well as in Brooklyn, and surrounding towns. Another office has been opened in Philadelphia in the Drexel Building, and within a few days a Boston office will be opened.

From the Western office at Chicago, classes have been organized in seven Western and Middle States aggregating in membership something over fifteen hundred students. Some of the classes have been in operation since June and have already covered one-third of the course which has a complement of forty-five lessons.

The course of study is arranged so that the first fifteen lessons are confined to demonstrations in the study of the fundamental laws of the science, and the balance of the course is given to the applications of those laws in the construction and operation of commercial and scientific apparatus. The method of preparation of the lessons is thorough. Each lesson is first prepared by a member of the faculty, then edited by a duly selected editor, (also a member of the faculty) with a view to making the course harmonious as a whole. After being written and edited, each lesson is submitted to the several members of the faculty for criticism, and finally revised by the original writer, in the light of the criticisms and suggestions of his collaborators. The writer also submits with each lesson, a schedule of apparatus required for its demonstration and specific directions for the guidance of instructors.

Two special courses are already provided, in addition to the general course, one for railway men, and an electro-therapeutic course for doctors. Prof. Shepardson of the University of Minnesota, a member of the faculty of the school, has special direction of the railway course, and Dr. W. J. Herdman, Professor of Diseases of the Nervous System and Electro-therapeutics in Ann Arbor University, also a member of the faculty, has personal direction of the Electro-therapeutic course. Dr. Herdman is now preparing to surround himself with a special faculty of advanced workers in this branch of the science to collaborate with him. Already there are three classes of doctors in Chicago and within a week or two others will be formed in New York. In these special courses, the work of the general course is carried through the physics of electricity, and from that point the special applications of the current are taught. In the medical course it is contemplated to have the ablest surgeons teach the surgical applications

of the current, the best available talent on that subject teach the application of electricity in diagnosis, and so of nervous diseases, etc.

Most of the classes of the general course meet one evening each week, but some of them meet two or three evenings. Several of the classes are made up exclusively of stationary engineers and some exclusively of electrical workers. A feature of the school is the free admission of students of special talent who cannot pay even the small tuition fee charged. No pretension is made by the school management that the institution will fit its students, without further preparation, for expert positions. It is candidly admitted that the function of the school is to prepare students in the fundamentals of the science so that they may prosecute their studies in the various text books intelligently without the fear that these will "shoot over their heads" as it were. Nor is it claimed that the school is intended in substitution of college work, but is the best possible substitute for those who cannot, by reason of circumstances, avail themselves of college facilities.

In Chicago, where the school began its existence, the Board of Education of the public schools, thought so well of the work after it had been in operation for a short time, that the Board, by official resolution, granted the management the free use of public school buildings in which to hold class meetings.

OPINIONS OF STEAM RAILWAY MANAGERS ON TROLLEY COMPETITION.

THE present may, with truth, be called the street car age.

From far and near come reports of the extension of old lines and the projection of new ones, the direct results of improved methods in the application of electrical energy.

When it was demonstrated that the street car could be run at a higher rate of speed and at a greater saving in cost, as compared with horse power, every company in the land engaged in this line of business made haste to adopt the trolley system.

The West End company of Boston was one of the first, if not the first, in the field with its electric cars, the line running from the Park square station to the reservoir. An avalanche of protests swept down upon the company during the tentative period of these cars. The numerous accidents to passengers, the frequent giving out of the motors and the disfiguration of the streets by the overhead wires were some of the more important objections raised to a general application of electricity as a motive power to the street car system of the city.

But with improved machinery, greater caution on the part of the motormen, a higher rate of speed, more sumptuous cars, improved illumination and reduced rates of transportation, the pessimistic sentiment disappeared and in its place grew up a loyalty for the "electrics" that would come very near precipitating a riot were an attempt now to be made to abolish them.

While all this has been going on in the great cities, there has also been a gradual development of suburban lines, and important connections have been made with the roads running out of adjoining towns, until now one can take a trolley car at Scollay square and make a continuous journey to Marblehead; and this is only a sample of what is to come.

One of the results of these extensions is seen in the reduced revenues of many of the steam railroad companies. At first this new competitor for a part of their local business was pooh-poohed. They professed to have no fear of it, but after the establishment of a number of well equipped electric lines running parallel to the steam roads, there was a change of sentiment.

A growing lightness in the pockets of the big corporations made them stop and think. A very serious condition now confronts them, and they are attempting to meet it by reducing fares and cutting off trains.

The New York, New Haven & Hartford road, a corporation that is somewhat new to the experience that competition produces, is already feeling the sting of this "giant in infancy," and has announced the withdrawal of one of its trains on the Naugatuck branch as a consequence. In less than five years the four-track line operated by this company between New Haven and New York will be paralleled the entire length. Numerous instances could be given where local passenger traffic has also been seriously reduced by this young and very active bidder, and what is true of the Consolidated applies equally well to a number of the roads running out of Boston.

The receipts of the Boston & Maine between Malden and Boston since the adoption of the 5-cent fare on the electrics have shrunk at least 50 per cent., while the cash receipts of the Boston, Revere Beach & Lynn have felt the paralyzing effect of the Lynn & Boston, and this is only the beginning.

The *Railway Age*, in discussing this matter, says that "the competition of electric railways for local travel, and even for journeys of considerable length, not to speak of its probable extension to freight service, is rapidly constituting an important condition affecting the management of steam railways. * * *

* * * Altogether the rapid increase of trolley roads is a problem for legislation of very grave importance to the public as well as to

the existing lines of transportation that have built up the business upon which, for the most part, these roads expect to live."

The *Stockholder* takes this view of the situation: "We believe it (the building of electric roads) will tend to largely reduce the demand for stocks in the general list of the New York Stock Exchange. It will divert investment funds of interior banks into a new channel, for the opening of new electric lines means the development of the territory through which they shall extend."

The *New York Daily Indicator* looks at the subject in this light: "The competition of the trolley system of transportation with the steam surface railways is an indisputable condition, which no theory can upset. What will be the effect upon the established system of railway travel is not yet possible to see except in part. The trolley has had comparatively smooth sailing so far, but now that the steam railroads are making the discovery that their passenger business is in jeopardy, we predict the time will not be long before obstacles will rise up in the path of trolley progress such as its friends so far have never dreamed of. The New Haven railroad sounded the keynote in its wail of distress contained in the annual report published a short time ago, when it said: "The construction of electric railroads in the neighborhood of our property continues throughout all its territory. Wherever they seriously reduce the revenue of this property we shall be compelled to lessen local service in a corresponding degree, as pointed out in our last annual report. The creation of level crossings of steam railroads by electric roads, whether by legislative or judicial permission, must lead to dreadful accidents. The people are calling for large expenditures by the steam railroads for the elimination of all grade crossings, and simultaneously their agents are increasing the danger to those which exist by allowing the electric roads to use them. Public sentiment sooner or later will condemn such inconsistency."

The *Herald* believing that the presidents and general managers of the important railway combinations in the country had given this question careful study, and were therefore in a position to discuss it with a vaster degree of intelligence than the theorists yet have done, addressed a circular letter to them, and requested the benefit of their conclusions. While the answers, for publication, were not as numerous as hoped for, yet a sufficient number were received by which the reader can form a pretty good idea of the general impressions created by the advent of this new element in transportation.

Many of the views given are of the utmost importance from a practical standpoint, and should be carefully perused by all who take an interest in the progress of the age. Following are the questions submitted:

Have the steam railway companies anything to fear from the competition of local electric lines?

What is the future of electricity as an element in rail transportation?

If your road feels the competition of parallel electric lines, what action is contemplated to meet it.

The replies received are appended, the first one received being from Vice-President Odell of the New York & New England Company.

ELECTRIC RATES MUST BE MET.

Replying to your circular letter of September 19, I have to say that the steam railways seriously feel the effects of competing local electric lines. This is particularly true in all but four months of the year, and I doubt whether there is a city of any importance in the country where electric lines are not paralleling suburban steam railways. The steam railways do not, however, feel the effect to the full extent of the earnings of the electric lines, the electric lines themselves creating a business which might eventually compensate the steam railroads for some of its losses. In some instances that I have investigated the loss to the steam railways is not as great as it would be if its rates were reduced to the electric road's rates, and whenever the steam railways discover that in order to prevent serious loss they must meet the electric rate they generally do it, provided it does not affect the fares beyond the electric lines.

In regard to the future of electricity as an element in rail transportation it is difficult to form an opinion. I believe, however, that between two large cities, say, where the distance apart is about 40 or 50 miles, it is not improbable that electricity will be used. I doubt if any one living will see electricity substituted for steam to any greater extent than above.

There will soon be in operation three electric locomotives weighing, I think, 80 tons each, operating the Baltimore & Ohio tunnel under the city of Baltimore. Electricity had to be substituted in place of steam on account of the heavy grades in the tunnel, where steam locomotives would prevent the successful handling of the tunnel for passenger business. The operations of these electric locomotives will be watched with interest.

The above is about the extent of my investigation of electricity as a substitute for steam.

J. T. ODELL,

Vice-president New York & New England Railroad Company.

ELECTRICITY TO SUPERSEDE STEAM.

In reply to your first question, namely: "Have the steam railway companies anything to fear from the competition of local

electric lines?" my impression is that steam railways will not be seriously injured by the local electric lines, although at first sight it would appear probable that suburban trains would feel the competition. On the other hand, the local electric lines, radiating in short distances from populous centres will act as feeders to the steam lines, and while in some instances they may draw passengers from them, in others they contribute to the convenience of reaching steam line stations, and may even be considered as branches to the steam line system.

In Chicago, where, perhaps, the two methods of local transportation are more conspicuously contrasted, the steam lines seem to be constantly increasing in their suburban traffic, while the competition of the electric lines has been much more active. Several reasons may be given for such results. For example, competitive electric lines, while they are very convenient in the streets of a large city, are very much impeded in the crowded streets, and if they continue to the suburbs, delay all passengers living beyond the city limits, and as a rule passengers can take the steam lines from the stations and make a trip of eight or 10 miles much more expeditiously than by the electric roads. Still they offer many of the conveniences of cable and horse-cars, and will often be preferred on account of facility of access and freedom from schedule time. Passenger traffic, however, increases so rapidly in large and growing cities that I fancy the steam lines will not feel the inroads made upon their traffic by the electric roads.

When the elevated roads were built in New York, the horse-car companies anticipated heavy loss by the competition, but, as a matter of fact, the traffic of the horse-car lines, even under the very tracks of the elevated roads, has constantly increased.

As to your second question: "What is the future of electricity as an element in rail transportation?" I am inclined to believe that, eventually, electricity as a motive power, will supersede steam, but I do not think it will become an important factor in general rail transportation for long distances until the method of its application has been greatly changed and improved. It would be idle to deny great possibilities in the future of electricity, and I am a strong believer in its subtle potency as an agent in practical work, but I doubt very much whether man's intelligence has mastered its secrets sufficiently to count upon its constant and economical work for long distances. There are many serious objections to overcome, I think, before it can be considered a formidable rival for general transportation by rail. When these objections are overcome, I believe the steam roads are in the best position to avail of the power, and that they have such an advantage in construction and location, that they will be the first to utilize it successfully. It does not appear to me that this condition is yet in sight, but as to this I may be mistaken. I believe electric power to be a giant, still in infancy. Its growth has already been abnormally rapid, but it will require long study and experience to develop its great capacity, and to teach us the best method of controlling and utilizing it.

Your last question, "If your road feels the competition of parallel electric lines, what action is contemplated to meet it?" is easily answered. The road which I have the honor of representing has no such competition. Action, therefore, is not required.

O. D. ASHLEY,

President of the Wabash Railroad Company.

SERIOUS PROBLEM PRESENTED.

I am favored with your letter of the 19th ult., asking for my opinion on stated questions with reference to local electric lines, and the future of electricity, as an element in railway transportation, etc.

There is, I think, no doubt that the competition of local electric lines for suburban traffic may become a serious matter for railway companies. They have to purchase costly property, construct embankments and bridges, fencing, over-bridges and subways, to keep an extensive staff at crossings, to reduce speeds, and to do all that is humanly possible to prevent accidents.

On the other hand, the electric lines run over public roads already made, employ none of the expensive surroundings of the railway companies, attain sometimes dangerous speed, and take few adequate precautions against accident—which, in fact, having regard to the circumstances, they cannot do.

With respect to the adaptation of electricity to railway purposes, it is impossible to conjecture to what extent this wonderful agent may be developed, but, so far as its present adaptability is concerned, electricity would be too costly, and could not be adapted to all requirements of the railway service. I found that to be so, when considering the question, in connection with the working of a short piece of line, between A and B., not long since.

L. J. SARGEANT,

General Manager of the Grand Trunk Railroad Company of Canada.

AN IMPORTANT FACTOR.

Your note of the 19th is just received, and I note your request for my views upon the future of electricity as an element in railway transportation, and its probable effect upon steam lines.

I regret that I have not time to answer these questions fully, but my impression is that, for short passenger roads, electricity is going to be an important factor in transportation, though to just how great an extent I do not of course know, but for long roads, carrying heavy tonnage, I do not believe it will ever take precedence over steam. It is possible that the time may come when roads which now use steam may find it more economical to use electricity in many places.

C. P. HUNTINGTON,

President of the Southern Pacific Railroad Company.

BUSINESS WILL BE DIVERTED.

Replying to yours of the 19th ult.:

1. It is my opinion that such steam railway companies as do a large suburban business will find considerable of that business diverted from them by local electric lines.

2. It is impossible to tell what is the future of electricity as an element in rail transportation.

3. Our company has felt the competition of electric lines but little. We have never devoted much attention to the development of suburban business, because our situation has not required it. Unless suburban business is very large, I do not think there is much profit in it for steam railways, and therefore we have viewed the extension of electric lines without alarm. In our territory they have thus far only affected suburban business.

ROSWELL MILLER,

President of the Chicago, Milwaukee & St. Paul Railroad Co.

THE COMING MOTIVE POWER.

I have your circular letter of the 19th, and in reply would say there are really so few electric roads in this state that this road has not been affected by the competition as yet, nor have we any reason to fear anything from it in this state.

In regard to the future of electricity, so many astounding discoveries have already transpired in electricity, one cannot but believe that sooner or later it will constitute the motive power in connection with rail transportation.

E. P. SMITH,

President of the Vermont Central Railroad Company.

TOO EARLY TO SPECULATE.

Answering yours of the 19th ult., would say that I have had no experience with the competition of local electric lines. I do not like to speculate upon practical questions, consequently am not able to say more until I am more competent to do so.

J. D. LAYNG,

General Manager of the West Shore Railroad Company.

OTTAWA'S ELECTRIC SYSTEM.

The Montreal *Herald* says that four years ago the right to build and operate an electric railway in Ottawa was going a-begging. There were few who were daring enough to believe that the enterprise gave reasonable expectation of profitable investment. The result, however, is that it has paid a handsome dividend from the start. The road is controlled by the firm of expert electricians, Messrs. Ahearn and Soper, who built and equipped it, and it is recognized as a model of its kind. It was the pioneer electric railway of any importance in Canada, and its management were the first to demonstrate the practicability of giving an uninterrupted service throughout the winter season.

A DECENNIAL ISSUE.

OUR esteemed and always excellent contemporary the *Street Railway Journal* has issued a beautiful decennial number, in honor of its tenth anniversary, and of the Atlanta meeting of the American Street Railway Association. It contains a 16-page article on Atlanta, a 10 page article on the Association, a 30-page article on the street railway systems of the Southern cities, and a 20 page article on the history of the street railway industry. All of these are handsomely illustrated—containing over 400 illustrations, among which are more than 125 portraits of street railway men. Altogether it is one of the finest examples of technical and trade journalism ever seen.

OBITUARY.

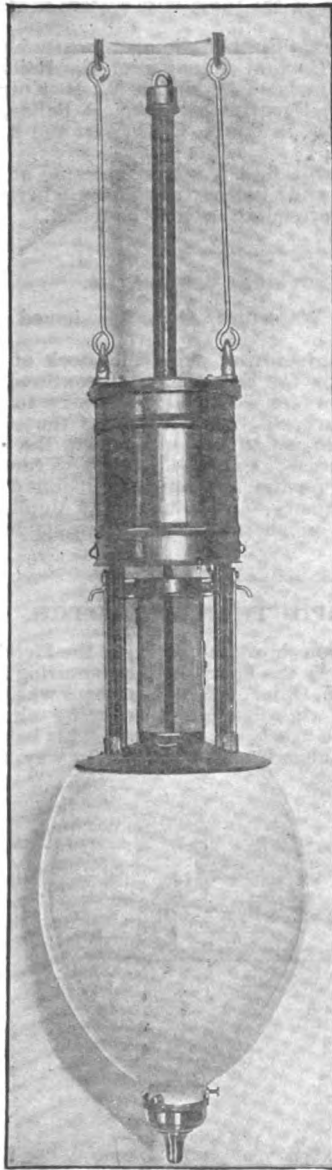
MRS. G. M. PHELPS, SR.

We regret to record the death of Mrs. G. M. Phelps, widow of the late electrician and inventor, and mother of the president of THE ELECTRICAL ENGINEER. Mrs. Phelps although over 70, was in excellent health until recently, when she had the misfortune to fall while alighting from a coupé at the door of her residence in Brooklyn, breaking a leg. This shock to her nervous system proved more serious than the direct bodily injury, and she gradually succumbed. The funeral service was held at her late home in Brooklyn on Wednesday last, and the remains were then taken to Troy for interment in the family lot.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE THOMSON '93 ALTERNATING ARC LAMP.



To satisfy a growing demand, the General Electric Company has placed upon the market a modification of the Thomson '98 arc lamp adapted to alternating current circuits. With the Thomson '93 alternating lamp shown in the accompanying engraving no external or wasteful resistance is employed; the feeding mechanism is positive, the parts durable and interchangeable, and the regulation perfect. In principle the feeding mechanism is a rack rod and escapement operated and controlled by an entirely new method. The rack rod is free to move in both directions without strain on the escapement. The arc is started without any of the objectionable "jumping." The mechanism is simple in the extreme, and requires no adjustment before installation. All the different styles of lamps—standard, short, focussing, etc.—are provided with reflector and spark arrester. The globes may be lowered rapidly and the carbon dust speedily removed.

These alternating arc lamps of a nominal 2000 C. P. are designed for a current of 13 amperes and are adjusted for that current unless otherwise desired, to be connected in parallel on 32 volt circuits. Each is an absolutely independent unit. The 32 volts can be obtained from the secondary of the transformer, and such transformers wound for 32 volts in the secondary, and of desired capacity, are built by the General Electric Company.

It is evident that the great commercial advantages attendant on incandescent lighting by alternating current

equally obtain for the alternating arc lamp. If arc lighting alone is to be undertaken, the 2,080 or 1,040 volt dynamo feeders run in a central point of distribution, thence the mains carry the current to the transformers, from the secondary of each of which one or more lamps may be operated. In the case of the 2,000 volt primary circuits, there will be but $\frac{1}{2}$ ampere per lamp, and in the case of the 1,000 volt primaries $\frac{1}{4}$ ampere per lamp. Thus the line losses are reduced to a minimum.

Four hundred and twenty-five watts is the energy required for each standard lamp of 13 amperes at 32 volts in calculating for the transformer capacity to be installed or permissible number of lamps to be run from transformers already installed but only partially loaded. In the latter case compensator coils may be used for changing the 52 or 104 volts, usual for incandescent lighting, to the 32 volts required for the arc lamp, the change being effected in the compensator coil with practically no loss of power.

With any alternating current arc lamp the exclusive use of cored carbons designed for alternating current lamps is essential. With the standard lamp $9\frac{1}{4}'' \times \frac{1}{8}''$ or $\frac{1}{4}''$ cored carbons are used, giving a life of from nine to ten, or eleven to twelve hours respectively. With the short and focussing lamps, if about the same life is required, $7'' \times \frac{1}{8}''$ cored carbons are used. American uncured carbons or even common cored carbons designed for direct currents cannot be used, and, moreover, their use would

prove very expensive because of the increased potential which they would require (over that required for soft carbons) when used for alternating current work.

ANDERSON TROLLEY LINE APPARATUS.

The accompanying illustrations show the new straight under-running trolley frogs and crossings and section insulators of Messrs. Albert & J. M. Anderson, 289 to 293 A street, Boston. Every engineer who is familiar with the construction and opera-

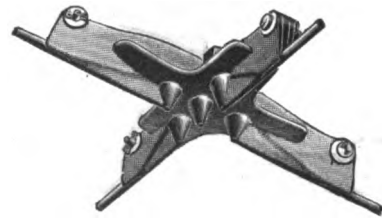


FIG. 1.

tion of the trolley system, knows the value of a practical, straight under-running frog and crossing to avoid the dipping and consequent sparking of the trolley wheel in passing under them, as well as the tendency to jump the wire at these places. It is an

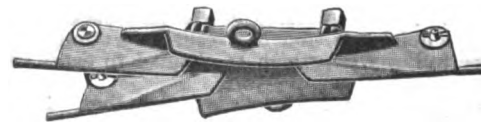


FIG. 2.

easy matter to make a frog that is straight under-running before it is subjected to the strain of the trolley wire, but by a careful investigation of the needs in this direction, and a number of experiments, this firm have devised a construction, Figs. 1, 2 and

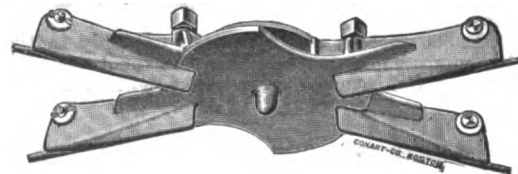


FIG. 3.

3, that is strong and will not, it is claimed, buckle under the line tension, but will remain flush under-running. It is not heavy or clumsy, and is so constructed that no soldering is necessary.

A prominent engineer of one of the largest electrical railroads

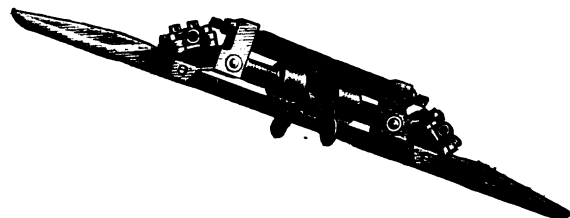


Fig. 4.

has remarked concerning these frogs and crossings, that they are the greatest improvement in trolley line fixtures that he has noted for some time.

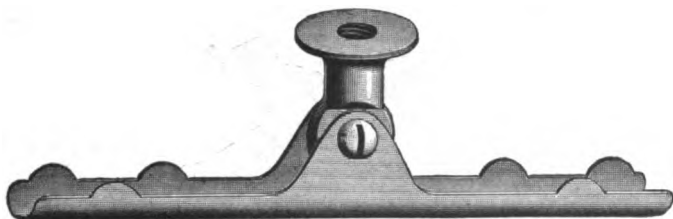
The new section insulator, Fig. 4, which is also flush under-running, is made for permanent construction.

LOUISVILLE ELECTRICAL WORKS.

WE note the organization of a new electrical enterprise under the above title at Louisville, Ky. Mr. Campbell Scott is General Manager. This house will manufacture electrical and mechanical specialties and will also give attention to the repairing of electrical and other machinery. Their address is 148 Fifth Street, Louisville.

THE JEWELL TROLLEY SLING.

THE accompanying illustration shows a view in perspective of the Jewell trolley sling, which the Ohio Brass Company of Mansfield, Ohio, have recently made arrangements to manufacture. This ear is especially adapted for trolley suspension on straight line work where a flexible support is desired, as is the case particularly when the ordinary pole bracket construction is used. The lug into which the hanger stud is threaded is swiveled in the body of the ear, so as to admit of an oscillatory motion



JEWELL TROLLEY SLING.

when the trolley wheel passes under it. This overcomes to a large extent the pounding effect of the trolley wheel on the insulator.

In putting the sling on the trolley wire the swivel bolt is first unscrewed, and the lug removed. The wire is then dropped into the groove and the lips are bent over it, securing it in place. The lug and bolt are then replaced, and the ear fastened on the hanger body. As no soldering or special tools are required, this operation is a quick one, and the result is a strong, flexible support for the trolley wire, which is claimed to cause no arc when the trolley wheel passes.

The standard length of the ear is nine inches. It is made of a composition brass metal, which is especially adapted for this class of work.

THE GENERAL ELECTRIC COMPANY AT THE ATLANTA CONVENTION.

THE exhibit of the General Electric Company at the Atlanta Convention will be of an elaborate nature befitting the importance of the occasion. It will comprise motors, controller, other car equipment parts, station switchboard panels, line material, wattmeters, etc.

The G. E. 800 motors will be shown not only in the exhibit proper, but mounted on cars operated over the lines of the Atlanta Street Railway Co. Ample opportunity will be afforded for a

exhibit, which will be illuminated by means of Thomson 75 arc lamps for railway circuits connected in series and operating on the railway lines. They have been especially designed for use in power houses, carbarns and elsewhere where light is desired from 500 volt circuits.

The exhibit will also comprise samples of underground feeder tubing with models of junction boxes and taps, and amongst the literature which will be distributed will be found a special pamphlet dealing with the application of the three-wire system to street railway work.

The interests of the General Electric Company will be in charge of Mr. W. J. Clark, General Manager of the Railway Department. He will be ably assisted by Messrs. W. H. Knight, Chief Engineer of the Railway Department; Theo. P. Bailey, H. H. Corson, H. J. Crowley, W. B. Potter, H. C. Wirt and A. K. Baylor.

Visitors to the Convention will find a warm welcome at the Atlanta office of the Company and, indeed, anywhere where the General Electric Company's representatives may be found.

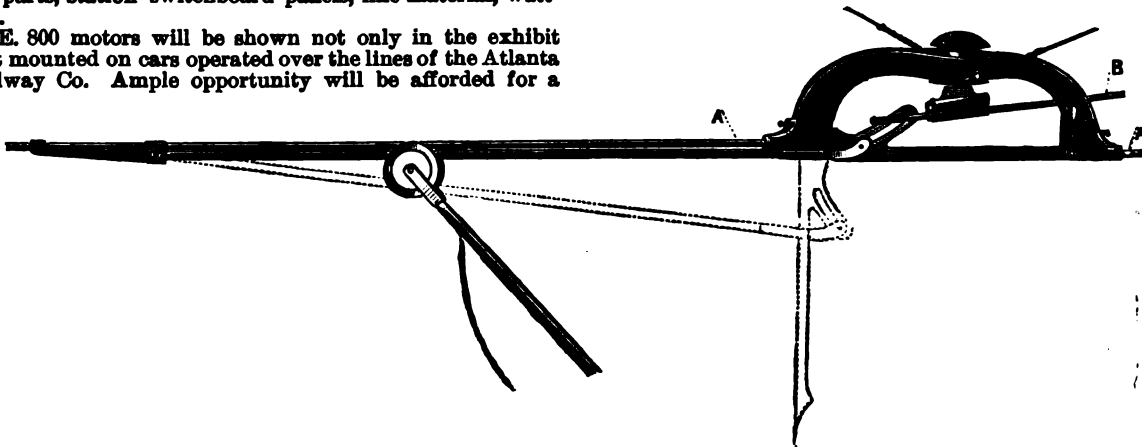
THE RELIANCE ELECTRICAL APPARATUS.

Mr. John W. Thompson, Waterford, Ont., has issued the following notice to the trade:—

I have purchased the manufacturing plant and stock of the Reliance Electric Manufacturing Co. Estate and will continue the manufacture of the highest grades electrical machinery for all kinds of lighting and power purposes. The extent of the stock and the price paid will enable me to give purchasers the best electric apparatus at lowest prices. I am in a position to furnish and give special attention to repairs and renewals required for any make of electrical machinery, and can supply duplicate parts of Reliance apparatus on short notice. Correspondence solicited.

THE FLETCHER RAPID TRANSIT SWITCH.

The accompanying illustration shows the action of the Fletcher "Rapid Transit" switch made by the Fletcher Manufacturing Co., of 41 N. Jefferson street, Dayton, Ohio. It provides means whereby two trolley lines crossing at right angles, or running almost parallel to each other, may be freely used by two roads having separate electric currents, without interference in any way, and



FLETCHER RAPID TRANSIT SWITCH.

close and critical examination of these motors and of the component parts which enter into their construction. The motors shown in operation will act in conjunction with the "K" controller, and those interested will be enabled to investigate the merits of the combination. The principle of the magnetic blow-out device will also be shown and explained and its action demonstrated. This principle is embodied in all other devices in which electric arcs may occur, such as switches, fuses, lightning arresters, etc.

Several sizes of generator and feeder panels for station switchboards, all of black marbled slate, with the necessary instruments mounted thereon, will also be shown. These panel boards are made in various capacities to suit the requirements of the plant, and have been devised so that the switchboards may be increased in size as the station grows, merely by the addition of other panels.

The line material exhibited will embody several improvements of an important character, which have become necessary by the increased demands of railroad service.

The Thomson recording wattmeter in its portable form for testing on moving cars will also form an important item of the

without slowing up the speed of the car or pulling down the trolley pole of either road.

The title "Rapid Transit" is used advisedly as the trolley, be the speed ever so rapid, will, it is claimed, pass over the switch without the slightest shock to the switch or interference with the current. The makers have tested the switch up to a speed of thirty miles, and are confident a test of sixty miles would show equally favorable results.

In the illustration A A shows the trolley line of which the Fletcher switch forms a part, and B a trolley line crossing it and suspended underneath the arch in an insulated clamp. The switch is shown with the gate closed, ready for the trolley wheel to pass over. Dotted lines show the position resumed by the latch and rod after the trolley wheel has passed over the switch, leaving the line B ready for use when required.

HARRY S. SMITH & Co. have the contract for installing 75 Colvin telephones in the Bartram Apartments at West Philadelphia.

THE KEYSTONE "TYPE K" INSTRUMENTS.

The accompanying illustration shows the "Type K" ammeter, made by the Keystone Electrical Instrument Co., of Philadelphia, for which the George L. Colgate Co. of this city is sole agent.

These instruments are pleasing in appearance; and as they contain no permanent magnets or springs are therefore not liable to deterioration. All moving parts are mounted in jewel bearings and the case is thoroughly dust-proof. The voltmeters are of high resistance, thus requiring a minimum amount of current and may be left in circuit continuously without affecting the readings. There is also said to be an entire absence of magnetic lag and no heating error. All moving parts are magnetically shielded so that the effect of external magnetism is not appreciable.

The scales in the "Type K" instruments are large, with generous divisions and so arranged that within the limits of the scale, readings may be obtained to about $\frac{1}{4}$ of the division points marked.

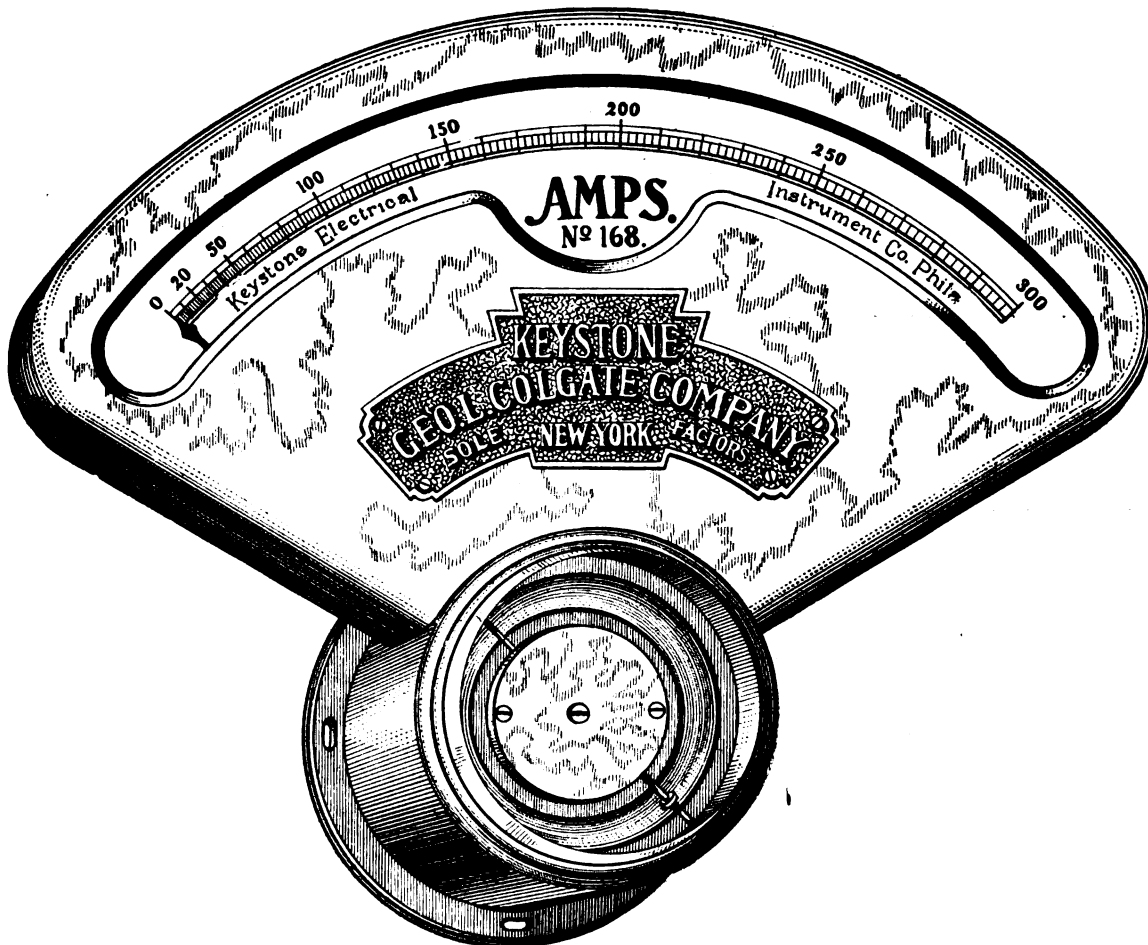
The instruments are very easy to set in position on switchboards,

office that the call has actually been sounded. The dispatcher's office, by having a distinctive combination of dashes for each office can thus call up any one without disturbing the bells at the other. These instruments have been tested several months by the Baltimore & Ohio on long circuits.

BLISS FRICTION CLUTCHES.

The E. W. Bliss Co., of Brooklyn, have been users for some time past of a large number of friction clutches, nearly every geared machine built by them being operated by one. Until recently they have purchased these clutches in the open market, but became convinced that none offered for sale were as good as could be made, and they determined to procure something better than they could buy. They have, therefore, procured patent rights and have established a special plant for the manufacture of clutch pulleys.

Their elaborate system of special appliances insures all parts of



THE KEYSTONE "TYPE K" INSTRUMENT.

the only requirement being that they shall be plumb. This is easily accomplished by seeing that the needle points to zero when no current is flowing through the instruments. The holes in the flange of the case to receive the screws which fasten the instrument to the board, are slotted to allow the adjustment to be made after the instrument has been placed, or to adjust it in case the switchboard should get out of level.

Each instrument after calibration, is sealed in such a manner that it is impossible to inspect the moving parts without breaking the seal. A calibration card accompanies each instrument shipped, giving the number of instrument, certifying to the correctness of calibration at a given temperature and, in the case of a voltmeter, the resistance of the coil is also stated.

ELECTRIC SELECTORS ON THE B. & O.

The *Railroad Gazette* says that: The Baltimore & Ohio has given an order to the Electric Selector & Signal Co., 45 Broadway, New York City, for some of its instruments for use at small stations on the main line. These instruments consist of a loud call bell, set ringing by the selector, and which will continue to ring until the operator answers, a selector which acts when a certain combination of dashes is sent over the wire, and an "answer back," which transmits a signal assuring the calling

the mechanism to be interchangeable, and of the highest class of workmanship.

The friction disc is flexibly connected to the pulley against the sides of which the clutch members grip. Therefore, if the pulley wears out of true on the shaft, no difference results in the operation of the clutch, no undue strains are brought on any of the parts, and no adjustments are necessary to compensate for this wear. There are only two clutch members, one keyed rigidly to the shaft to which the levers are attached, and the other movable. This makes the adjusting of the clutch a very simple matter. The levers are so balanced that at any speed at which the clutch is run the centrifugal force has no tendency to throw the clutch in or out of operation.

The clutch is constructed with very few parts, and is so put together that it cannot readily get out of order. Its clutching members are circular and concentric with the shaft, the only projecting parts being the levers, so that it not only presents a pleasing appearance when revolving on the shaft, but is in accurate balance, and may be run with safety at any reasonable speed. It is very compact, and occupies small space on the shaft. The system of bushings for pulleys is so arranged that if on account of long continued use, or where a poor quality of lubricant is used, the bore becomes worn, the bush can be returned and exchanged for one with a new lining.

HOW TO USE MICANITE.

With reference to the recent articles and notes in our pages on the uses of mica and micanite, the Mica Insulator Co., of this city, sends us the subjoined interesting item:—

An important point in making or refilling commutators is the necessity of applying heat during the process of building, and from long experience we will guarantee the following method to give perfect satisfaction, and be a cure for such ills as loose bars, cement oozing out, or oil soaking in, if micanite segments or rings are used.

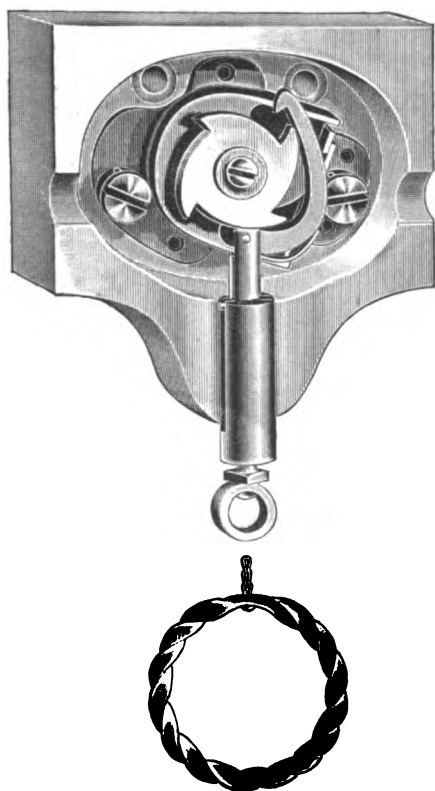
After assembling the commutator, heat it to about 300° F. or just enough to make micanite pliable, then tighten the bars or rings as much as possible. The pliability of the micanite will allow the distribution of unequal strains and will counteract to a great extent irregularities in the dimensions of other parts of the commutator. Then continue the heating, but this time let it reach 400° F., or until the shellac, which will have oozed out here and there, has become dry. In fact the shellac may be partially carbonized with no bad results. Then retighten the commutator either hot or cold, but preferably in both states. Do not tighten during the progress of this second heating, but wait until the shellac is baked dry.

When no proper arrangements are provided for heating, the commutator can be put for a few minutes inside a boiler furnace door, or on a gasoline stove, or on a plate placed over a blacksmith's forge.

We trust this method will be followed out in all cases, both with the micanite segments and rings; and it will be found that a commutator so built is extremely firm and satisfactory in every respect.

THE BRYANT CHANDELIER SWITCH.

New mechanical devices, which give greater ease and facility in the handling of the electric current, are created by the demands of the people and appreciated by them. The Bryant chandelier switch, which we illustrate, is one of the devices created by this demand. It consists of a single pole switch of 5 ampere capacity. This switch is mounted inside of a block of porcelain, and instead of an ordinary handle a four-pointed hard-burned porcelain



BRYANT CHANDELIER SWITCH.

ratchet is fastened to the turning spindle. A pawl or hook attached to a brass rod working inside of a brass tube, acting as a guide, is forced by a spring to a certain point, where it is always engaged or caught in one of the projections of the ratchet. At the lower extremity of the brass rod a chain of any length is attached. One pull turns on the lights, the next puts them out—"Just the plan for a little woman," was the remark of

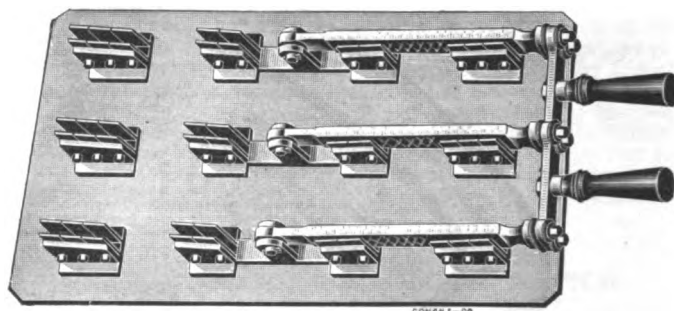
a busy and delighted housewife, as she pulled the chain of one of these switches.

The lamps on a chandelier are placed ordinarily so high that a woman of the usual stature must either get a stool or make an unhandy stretch to reach them, and in the dark there is more or less trouble to get hold of the socket keys.

Wall switches, when properly placed, are of great convenience, but when they have not been put in, the chandelier switch is just the contrivance to be used. It can be put under the canopy, secured to the pendant, and properly connected in a few minutes, no extra wiring being required.

W. S. HILL ELECTRIC CO.'S HEAVY CURRENT SWITCHES.

The illustration shows the new switch manufactured by the above Company, of Boston, for railway and lighting stations. For the past year these switches have been in use in very large numbers, one power station alone having over 300 in use of from 500 to 4,000 amperes capacity. The improvements (which are covered by patents) consist in broadening the ends of the blades



HILL HEAVY CURRENT SWITCH.

and yoke so as to admit of using two bolts. This unites the two so firmly that it prevents all twisting or straining of the parts while the switch is being operated.

The method of backing up the flexible brush contacts by plates of pure copper, converts the blade and contact practically into one continuous piece of metal, and as the size of all the carrying parts is computed at 1,000 circular mils per ampere, the makers claim that perfection has been attained.

The company reports business good in all its lines, but more especially brisk in switchboards, some of the largest and finest ones in the country having been lately turned out.

INVESTIGATION OF INDUSTRIAL CHANGES.

CONGRESS has directed the Bureau of Labor, to investigate the industrial changes caused by the expansion of productive capacity which has resulted in recent years from the more general employment of labor-saving machinery and of steam and electrical motive power. This investigation will be conducted under the oversight of Mr. Carroll D. Wright.

WESTERN NOTES.

MR. FOREE BAIN of the Great Western Mfg. Co., Duluth, Minn., was a Chicago visitor last week.

THE CHICAGO CENTRAL ELECTRIC R. R. Co., Chicago, was incorporated last week by G. W. Pateman, Wm. R. Odell and Charles A. Boos. The capital stock is \$300,000.

MR. LAFAYETTE COLE, who will be remembered as the traveling representative of Holmes, Booth & Haydens, is now in Kobe, Japan, where he is negotiating some important transactions in the electrical line.

MR. W. A. ROSS, Chicago manager of the Campbell & Zell Co. has been severely ill for a week past from pneumonia, but his physicians are now confident that the crisis is past and that Mr. Ross will soon be able to be about again.

Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE Electrical Engineer.

Vol. XVIII.

OCTOBER 24, 1894.

No. 338.

HERTZIAN WAVES, CARBON MICROPHONES AND "COHERERS."

BY

William James Morton, M.D.



ABOUT eighteen months ago I put into use in my office the Vetter method of controlling the strength of the current derived from the Edison 110 volt system of electrical distribution. The controlling devices were a 16 candle power lamp and a pulverized carbon rheostat. By these means a milliamperere, or fraction thereof, up to a hundred or more, if desirable, can be administered to a patient. (See diagram.)

On several occasions when the electrodes of the system above described were permanently attached to some part of a patient's person and a spark was being administered to another patient seated upon a platform charged by an influence machine, some fifteen feet distant in the same room, the first patient would exclaim and protest against receiving a considerable shock. On one occasion, when the continuous current electrode was in the neighborhood of a patient's temple, the patient experienced the sensation of a flash of light; on other occasions muscular contractions were produced, always simultaneously with the spark. Also upon the occurrence of the spark and shock the needle of the milliamperemeter, a vertical one and calibrated to a wide range of movement over five milliamperes, flew across the scale from, for instance, 2 to 5 milliamperes and remained at the higher reading. That a spark occurring fifteen feet away should cause a shock to a person in an independent circuit excited my wonder; it was inexplicable and yet so certain to occur that I was obliged to abandon the use of the two pieces of apparatus at the same time.

At last, when time permitted, I set out to investigate. I sought for an ordinary induction circuit of parallel wiring and found none. I then suspected the microphonic rheostat of pulverized carbon and having cut it out of circuit I substituted for it a water rheostat. The phenomena now failed to occur. Replacing the carbon rheostat and putting a telephone in circuit I adjusted the milliammeter to read 2 milliamperes, causing an assistant to evoke the distant spark. All was now clear. At each spark the needle jumped forward and a distinct telephone click was heard from the telephone receiver. I observed that the first jump of the needle was the longest as well as the first click in the receiver the loudest, both needle jump and click, dying away gradually at each successive spark until they ceased at from the twentieth to thirtieth. To turn the rheostat off and then on again rendered the experiment repeatable. The reading of the meter, best adapted to success, was about 5 milliamperes though 20 to 50 yielded good results.

Unable to furnish any reason why the electric radiation of a distant spark should reduce the resistance of pulverized carbon I refrained from publishing the bare observation in the hopes of finding an explanation by further experimentation, merely noting to friends the delicacy of the pulverized carbon rheostat as a detector of Hertzian waves and making some further experiments with it and a telephone receiver in circuit in this direction.

The recent publication in THE ELECTRICAL ENGINEER of the brilliant researches of Dr. Oliver J. Lodge now makes the entire matter clear. Dr. Lodge describes a new form of microphonic detector of Hertzian waves, consisting of two or more pieces of fairly clean metal in light contact and connected to a voltaic cell, a film of oxide of the metal intervening between the surfaces, "so that only an insignificant current is allowed to pass."

He writes: "Now let the slightest surging occur, say, by reason of a sphere being charged and discharged at a distance of forty yards; the film at once breaks down—perhaps not completely, that is a question of intensity—but permanently."

This detector, Dr. Lodge terms a "coherer" because of the partial metallic cohesion above described. Upon this point he says: "A bad contact was at one time regarded as a simple nuisance." * * * "Hughes observed its sensitiveness to sound waves, and it became the microphone. Now it turns out to be sensitive to electric waves, if it be made of any oxidizable metal (not of carbon) and we have an instrument which might be called a micro-

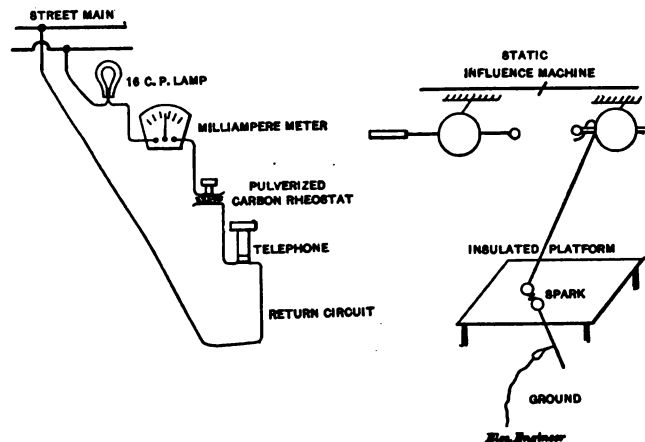


DIAGRAM ILLUSTRATING CARBON "COHERER" PHENOMENA.

something but which, as it appears to act by cohesion, I call at present a coherer." The cohesive result between the metallic surfaces is also referred to as a "welding effect of an electric jerk." In the volume just published, entitled "The work of Hertz, etc.," reprinted from the *Electrician*, London, this foot note is added: "Fitzgerald tells me that he has succeeded with carbon also."

My experiments would seem to fully demonstrate that carbon as well as metals may act as coherers. At some recent trials the editors of THE ELECTRICAL ENGINEER were present and were fully satisfied as to the swinging up of the needle of the milliamperemeter and the click in the telephone receiver, by repeated tests.

The experimental side of the subject has been so exhaustively and admirably presented by Dr. Lodge (detailed in the publications referred to) that what is here said has no more than a secondary interest. But it may not prove amiss to gather together all the evidence which tends to

1. The work of Hertz and some of his successors. — THE ELECTRICAL ENGINEER, July 4, 11, 18 and 26, 1894.

demonstrate the influence of disruptive discharges upon neighboring bad contacts conveying currents. As Lodge points out, fuses may easily be "blown out" in this manner. This has occurred to me on a number of occasions with 10 ampere fuses. Under proper conditions of sparking surfaces and circuit a short spark might suffice.

May it not also be the fact that the fuses melted during thunderstorms in their neighborhood are melted by reason of the effect of the electric radiations or surgings of the lightning-stroke throwing a rush of the current already in the circuit through the fuse rather than by the addition of any new current to the circuit by the atmospheric electricity itself. In this connection Lodge writes: "There are some who think that lightning flashes can do none of these secondary things. They are mistaken." In this as in other directions the new facts have a practical bearing and a pursuit of further experiments may lead, as often happens, to unexpected developments.

So far as carbon contacts are concerned and the fact that Hertzian waves, like mechanical motion, reduce their resistance, a curious problem is suggested as concerns the principle upon which some carbon transmitters act. An exclusive monopoly of all carbon transmitters is based upon the claim that the variations in resistance are produced by variations in *pressure* due to a mechanical force, viz.; sound waves. If my experiments, above detailed, are exact, two facts appear:

1. That another form of motion, ether vibration, causes a variation of resistance of carbon contacts.
2. That it remains to be proved that variation of *pressure* is the only means of varying the current strength, for variation of molecular contact occurs in the present instance without any evidence that it is due to variation of pressure.

ELECTRICAL MACHINIST PRACTICE.—VI.

BY

James F. Hobart,

It is hard to conceive a more worthless or aggravating piece of mechanism than a short circuited coil, be it on armature, field or converter, and it is interesting to note how small and insignificant may be the contact which spoils the coil by short circuiting. It is then, necessary that extraordinary precaution be taken to prevent accidental contact by frequent testing during the process of winding.

The method commonly used, that of testing by a magneto, is only a makeshift. It is not a perfect test, and may be considered as merely a way of getting rid of a little extra work, or avoiding the necessity of procuring instruments. Indeed, magneto testing, in comparison with bridge testing, is like driving a screw into woodwork with a hammer, instead of turning it in with a screw driver. I once asked of a man who was thus abusing a screw: "What is that slot for, in the screw head?" His reply, very much to the point, was: "To turn the screw in with, when the boss is around, and you don't dare to drive it!"

Too many mechanics are "driving it in" by getting along with a magneto, instead of a bridge, and as a consequence, the coils are worth, after winding, about as much as the screw was after driving. Still, there are exceptions to both. Some hammer-driven screws hold well, and some magneto tested work is very good, but, after all, the principle is wrong in both cases.

In armature winding it is necessary to put on a certain number of turns of wire, but in coil making, the winding should stop when a given resistance is reached, and the wire should be so chosen that the number of turns required

comes within the allowed resistance. Testing is therefore necessary at about the time the wire space begins to get full. The arrangement shown in Fig. 24, is handy for this purpose, as the resistance of a coil may be tested at any time during the winding. Still, this arrangement will not detect a short circuit at the time of its occurrence, and there might be a half dozen layers short circuited in the

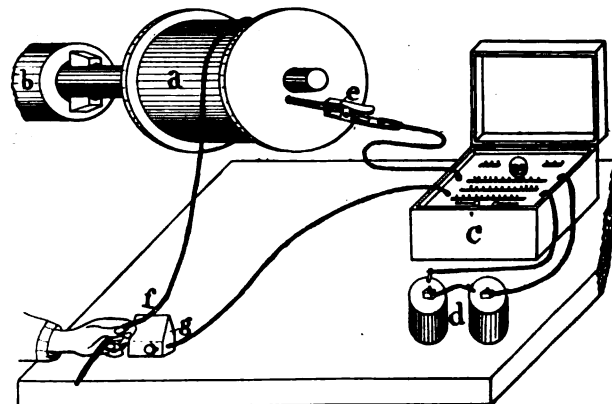


FIG. 24.

coil, with only the effect of getting a number of extra layers of wire on the coil, before the required resistance is obtained.

In the engraving, the resistance box, or bridge, *c* is plugged up to read at the resistance required for the coil *a*, which is placed on an arbor projecting from the lathe, or winding machine *b*. The battery *d* is connected in the usual way, one of the box terminals is wired to the clip *e* and the other terminal to the contact knife *g*. The clip *e*,

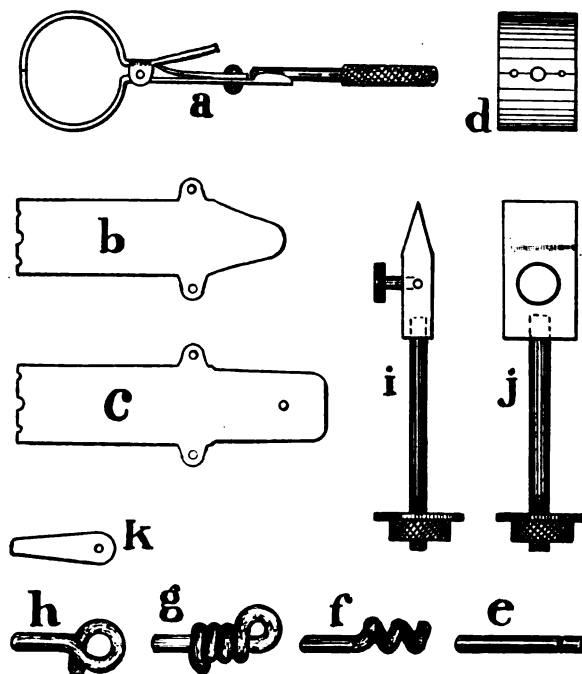


FIG. 25.

is so made that it will stay on the wire as shown, during the progress of the winding, and when it is desired to test the resistance of the coil *a*, it is only necessary to bring the winding-on wire in contact with *g*, and then close the key in the box *c*. The contact knife *g* easily penetrates the insulation without practically injuring it in the least. None of the insulating threads should be cut or broken while making contact.

The clip *e* is a little spring similar to those used on men's

suspenders. I have used such a clip for a long time, but prefer to make one like that shown at *a*, Fig. 25. It is easily made of spring brass cut out from the development shown at *b* and *c* and bent up as at *a*. An end view is shown at *d*, showing the notches for wires of different sizes. It is necessary that a notch smaller than the wire be used, in order to be sure that a good contact between the clip and the wire exists at all times.

If the wire be large, say, below No. 18, a shallow groove may be cut around it, with the cutting-nippers, as at *e*, and the clip will stay in the notch while the wire is revolving. If the wire is from 14 to 24, it may be given one or two twists around a bit of wire of its own size, and the central wire pulled out leaving the other in the corkscrew shape shown at *f*. This holds the clip well if the twist is made in the right direction. If not, the clip will run off like a nut following a thread.

A good twist for small sized wires is shown at *g*, and this, too, should be twisted in the right direction, so as to run with, instead of against, the end. A simpler form is shown at *h*, which answers for wires of medium size. The contact knife is shown at *i* and *j*. It is made of steel, with a brass or iron shank and brass binding parts and nut.

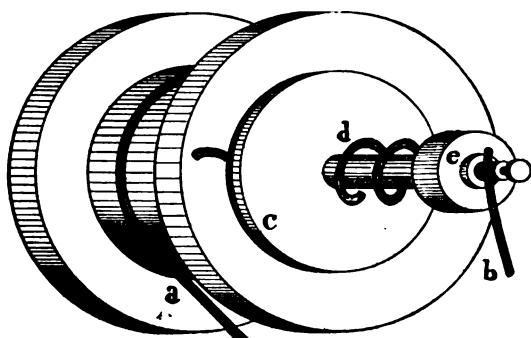


Fig. 26.

The engraving tells the story so well that no further description is needed.

For continuous testing, when winding coils, it is necessary to have slightly different connections. Instead of using a contact knife as at *g*, Fig. 24, another spring clip may be attached to the inner end of the wire on the spools. Or, that end of the wire may be attached to a ring on the spool or bobbin, and a brush used to make connection with the bridge. Such an arrangement is shown in Fig. 26, and it will be seen that the brush may also be used as a tension. In the engraving, the brush has been replaced by a spiral spring *d* which bears upon the brass washer *c*. This in turn bears upon the end of the wire which projects through a hole in the spool, and has been stripped of its insulation. The collar, *e*, tightens the spring, giving any desired amount of tension. The wire *b* goes to the resistance box, and *a* goes to the coil which is being wound.

To use this device for continuous testing during winding, connect up the bridge so as to measure the resistance of the entire spool of wire, connecting from *b*, Fig. 26, to *e*, Fig. 24. In measuring the resistance, use the highest dividing power of the instrument, in order that a very slight variation of resistance may be noted. Supposing that a six inch core is being wound with No. 20 wire. In order to detect the short circuiting of a single turn of wire, it is necessary that the galvanometer respond to a variation of about .013 ohm in the resistance of the wire. This can be easily done with the ordinary "testing set" connected up as above directed.

In accurate bridge measurements, it is necessary that there be a certain proportion between the resistance to be measured. The resistance of the battery used, and the resistance of the galvanometer. These refinements are seldom taken into consideration in mak-

ing ordinary bridge measurements, but I speak of them here so that in case the bridge does not work down as closely as desired, the operator will know where to look for the reason.

In winding a coil under continuous inspection, it will be noted that the resistance increases slightly as the wire is wound into place, this is caused by the bending, which hardens the wire, thus slightly increasing its resistance. The difference, however, is very slight.

It is not necessary to have a \$100 testing set, or bridge, in order to make continuous tests while winding coils. If a good galvanometer is at hand, the mechanic can put together a "continuous testing apparatus" which will do the work fully as well as the most costly bridge. To do this, it is only necessary to pick up two proportional resistances, say, of 1 and 1,000, or 10 and 1,000 ohms each, and arrange them as the arms of a bridge. Three lamps in series will make a good 1,000 ohm resistance; then with the wire connected as described, for testing during winding, it is only necessary to balance the bridge by cutting in lamps, old coils, or any handy resistance. For the adjustable resistance, string fine iron wire on nails driven into cleats on the wall; the nails may be put about far enough apart to allow one ohm resistance to the wire between them, then the adjustment may be made by attaching the bridge connection wire to any one of the resistance wires by means of one of the clips already described. One or two forms of these "home made" resistances will be described in a later chapter.

MAGNETIC LEAKAGE IN DYNAMO-ELECTRIC MACHINERY.—VII.

BY

Alfred E. Wiener.

b. Ampere Turns for Air-Gaps.

The *M. M. F.* required to produce a magnetic density of $\mathcal{K}$ lines of force per square inch in the gap-spaces,—since the reluctivity of air is a constant, and does not depend upon the density,—is directly proportional to $\mathcal{K}$, and can be calculated from:

$$at_k = \frac{10}{4\pi} \times \mathcal{K} \times \frac{l_k}{2.54} = 0.3133 \times \mathcal{K} \times l_k \dots (52)$$

where $\mathcal{K}$ = Field Density, in lines of force per sq. inch ;

$$= \frac{\Phi}{A_k}, \text{ in which } \Phi = \text{Useful Flux, from formula}$$

(1) or (2), respectively ;

and A_k = Area occupied by the effective Armature Conductors ;

l_k = Length of magnetic circuit in air-gaps, from formula (17), or (18), respectively.

In *smooth-core* armatures, the area A_k occupied by the effective conductors is approximately equal to the gap-area, A_g , calculated from formula (19), and in this case we have:

$$\mathcal{K} = \frac{\Phi}{A_g} \dots \dots \dots (53)$$

For *toothed* armatures A_k cannot directly be calculated from the dimensions of the armature-core, since the path area of the actually useful flux cutting the conductors depends upon too many conditions to formulate it satisfactorily, and it is, therefore, advisable to compute the field-density, $\mathcal{K}$, directly from the electrical data of the armature:

According to a well-known definition, 1 volt of *E. M. F.* is generated in a wire of unit length, 1 cm., cutting 100,000,000 c. g. s. lines of force in unit of time, 1 second,

or moving in a field of 10^8 lines per sq. cm., at a linear speed of 1 cm. per sec. From this it can easily be deduced that a wire of 1 foot length moving in a field of a density of 1 line per sq. inch at a velocity of 1 foot per sec., generates

$$\frac{30.48 \times 30.48}{100,000,000 \times 6.45} = 144 \times 10^{-8} \text{ volt.}$$

If two wires of 1 foot length each are connected in parallel, the E. M. F. generated per foot of wire will be one half the above amount, or 72×10^{-8} volt; and in an armature of p' pairs of parallel circuits, every foot of the effective wire will produce

$$\frac{72 \times 10^{-8}}{p'} \text{ volt.}$$

If then, an armature has L_e feet of effective wire, and moves in a field of density, $\mathcal{K}$, with a speed of S feet per second, then the E. M. F. output of that armature will be:

$$E = \frac{72 \times 10^{-8}}{p'} \times L_e \times S \times \mathcal{K},$$

from which follows the field density:

$$\mathcal{K} = \frac{p' \times E \times 10^8}{72 \times L_e \times S} \dots\dots\dots (54)$$

where E = Total E. M. F. output of armature, in volts;
 L_e = Length of effective armature wire in feet, i. e. length of conductors exposed to the action of the field at any one time;

$$S = \text{Conductor-speed, in feet p. sec.,} = \frac{d_a' \pi}{12} \times \frac{N}{60}$$

d_a' = Mean winding diameter of armature, in inches.

N = Speed, in revolutions per minute;

p' = Number of pairs of parallel armature circuits;

$p' = 1$, in case of series grouping,

$p' = p$ (Number of pairs of poles), in case of parallel grouping.

Formula (54) must be employed in case of *toothed* armatures, and may be used for *smooth* cores to check the result obtained by (53).

c. Ampere-Turns for Armature Core.

Owing to the magnetic resistance of the armature body, this portion of the magnetic circuit, in order to set up in it a specific magnetic induction of $\mathcal{B}_a$ lines of force per sq. inch of cross-section, necessitates, according to formula (51) a magneto-motive force of

$$at_a = f(\mathcal{B}_a) \times l_a \dots\dots\dots (55)$$

where

$\mathcal{B}_a$ = Density of Lines per sq. inch of armature-core,

$= \frac{\Phi}{A_a}$; by A_a being denoted the average net iron

section of the magnetic circuit in the armature core, in sq. in., see formula (56) and (58), respectively;

$f(\mathcal{B}_a)$ = "function" of $\mathcal{B}_a$, giving the number of ampere turns required per unit of length (1 inch) to set up a specific induction $\mathcal{B}_a$ in the particular material; see Table III, for annealed Norway iron, or Fig. 51, respectively.

l_a = Length of magnetic circuit in armature core, in inches, see formula (59).

The mean net cross-section of the magnetic circuit in the armature core is the product of the net length and the mean depth of the core, and of the number of poles:

$$A_a = p \times b_1 \times (b_1 + b_2) \times k_a \dots\dots\dots (56)$$

p = Number of pairs of magnet poles;

b_1 = Length of armature core, in inches;

b_2 = Radial depth of armature core, in inches;

b_3 = Maximum depth of armature core, in inches;

k_a = Ratio of net iron section to total cross section of armature core, see Table IV.

For bipolar machines the maximum depth, b_3 , of the core is the largest chord that can be drawn between the internal and external armature peripheries, and can be expressed by the armature diameter, d_a , and the radial depth, b_2 , as follows, see Fig. 52.

$$b_3 = \sqrt{\frac{d_a^2}{4} - \frac{(d_a - 2b_2)^2}{4}} = \sqrt{\frac{d_a^2 - d_a^2 + 4d_a b_2 - 4b_2^2}{4}} \\ = \sqrt{d_a b_2 - b_2^2} = b_2 \times \sqrt{\frac{d_a}{b_2} - 1} \dots\dots (57)$$

Inserting (57) into (56), we obtain for bipolar armatures, p being = 1,

$$A_a = b_1 \times b_2 \times \left(1 + \sqrt{\frac{d_a}{b_2} - 1}\right) \times k_a \dots\dots (58)$$

The constant k_a , appearing in formulae (56) and (58), depends upon the kind of material used in building up the armature core (sheet-iron, iron ribbon, or iron wire), on the thickness of the lamination, and upon the manner employed in insulating the armature core laminæ. In the following

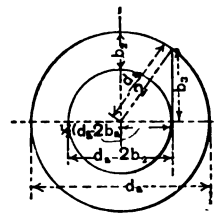


FIG. 52.

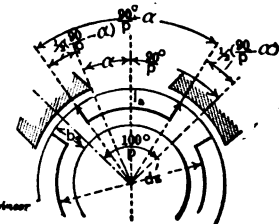


FIG. 53.

Table IV values of the ratio k_a of the net to the total core section, are given for various thicknesses of the iron and for the different modes of insulation now in use:

TABLE IV.—RATIO OF NET IRON SECTION TO TOTAL CROSS SECTION OF ARMATURE CORE.

Material.	Thick-ness, in inch.	Insulation.	Value of k_a .
Sheet Iron.....	.080	Paper, or Asbestos ...	0.95 to 0.90
" "	.040	" " " "	.92 to .88
" "	.020	Paper, or Enamel ...	.90 to .85
" "	.010	" " " "	.85 to .80
" "	.010	Oxide Coating.....	.95 to .90
Square Wire.....	.080	Cotton Covering	.90 to .80
" "	.040	" " " "	.85 to .75
" "	.020	Enamel, or Varnish..	.80 to .70
" "	.020	Oxide Coating	.90 to .85
Round Wire.....	.080	Cotton Covering	.80 to .70
" "	.040	" " " "	.75 to .65
" "	.020	Enamel, or Varnish..	.70 to .60
" "	.020	Oxide Coating	.85 to .80

The path of the magnetic circuit through the armature-core is illustrated in Fig. 53, from which it is evident that the length l_a can be expressed by

$$l_a = d_a' \times \pi \times \frac{90^\circ}{360^\circ} + b_2 \dots\dots\dots (59)$$

where d_a' = mean diameter of armature core, in inches;

p = number of pairs of magnet-poles;

α = half angle between adjacent pole-corners;

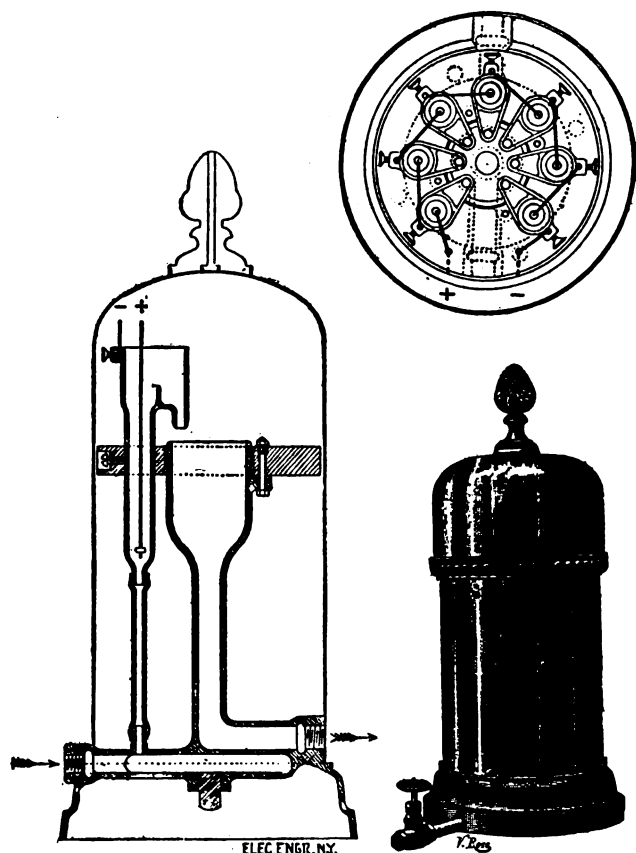
b_2 = radial depth of armature core in inches.

THE "HERMITE" HIGH TENSION ELECTROLYZER FOR ELECTROLYZING SEA-WATER.¹

THE accompanying illustrations show the details and method of working of an electrolyzer designed to meet the requirements of places where a direct electric current of 50 or 100 volts is available, whether from a public supply, or from a private electric light installation.

We have before referred to the Hermite process for deodorizing and sterilizing sewage, and to the demonstrations made by the inventor at Havre,² Brest, Worthing etc., with a view to its adoption on a large scale for supplying a powerful and cheap antiseptic, and laying it on in the streets of a town for flushing closets and disinfecting drains. The conclusion forced itself upon us that whether it could be economically applied on the scale recommended by M. Hermite or not, not a shadow of doubt existed that an antiseptic solution so powerful had many applications for the sanitation of hospitals, steamers, and buildings where present sanitary arrangements are made greater to provide immunity from peril.

So that such cases might be dealt with without waiting for a municipal supply of the electrolyzed sea-water or saline solution,



THE HERMITE HIGH TENSION SEA-WATER ELECTROLYZER.

an electrolyzer capable of being worked from an ordinary direct current of 100 volts, or less, has been designed.

It consists of a series of galvanized iron tubes, which form the negative poles of the electrolyzer. These tubes are separated by rubber tubing from a galvanized iron chamber common to all. The positive electrodes are of platinum. Connection is made between a supply tank of sea water, or of a solution of salt and magnesium chloride. The sea water enters the chamber and rises in the tubes, and the current being turned on becomes electrolyzed to a sufficient degree. It then overflows into the central pipe, from whence it makes its exit into the flushing cistern of the closet, or can be drawn off and carried away and used for any purpose of disinfection which the consumer may have in view.

The positive and negative electrodes are connected in series, and a current of about 15 amperes is made use of. Figs. 1 and 2 will explain the principle of the arrangement where the preceding description is not sufficiently clear. The apparatus is made in two sizes, one with seven and the other with fourteen tubes.

A series of tests have given a production of .8 gramme per ampere hour in each tube. With the larger electrolyzer it therefore follows that one hour's working will produce 80 gallons of solution at .5 gr. per litre of chlorine strength, which strength is far

more than sufficient for the destruction of any pathogenic micro-organisms.

The apparatus is fitted with a handsome enameled zinc cover, Fig. 3, so that its appearance does no discredit to the most elaborately fitted lavatory.

The cost of current used in producing 80 gallons of disinfectant, at half a gramme chlorine per litre, can easily be calculated, and will be found to be 1s., at the rate of 8d. per unit or 6d. if the usual reduced charge for day load is taken. To this has to be added the trifling cost of the salts necessary when sea water is not available.

It is manifest, therefore, that in a private house where only a few gallons per day would be required, the cost need not be considered; and that in a hospital or public building where large quantities of disinfectants are employed at a merely nominal cost, a disinfectant solution can be obtained as required which is more efficient than any other disinfectant, and free from any of their drawbacks.

On board a steamer fitted with the electric light, and with a salt-water supply always at hand, an unlimited supply of disinfectant can be produced at practically no cost. This is a matter of great importance for ships trading in the tropics.

DESTRUCTIVE ARCING OF 500 VOLT FUSES.¹

BY W. E. HARRINGTON.

The destructive effects of the arc accompanying the opening of 500 volt circuits with switches, lightning arresters and fuses, led the writer to inquire into this phenomenon, particularly in reference to fuse practice. A series of carefully conducted tests were made to find the relation between the fusing currents of different size copper wires ranging from No. 30 to No. 21, B. & S. gauge, the time required to open the circuit, and to what extent the arc contributed to the time required.

An inclined trackway was constructed, having two copper tracks, upon which a traveler, consisting of a block of hard wood having copper plates in contact with the tracks, could run, the circuit from rail to rail of track being completed through an electro-magnet on top of the traveler. Parallel with and alongside of the track was a raised board, on which a paper was attached. An impress was made on the paper by a lever on the traveler, when released by the magnet, owing to stoppage of current. Before tests were made the trackway was carefully calibrated as regards time for the traveler to go from top to bottom and the intermediate points, resulting in knowing the time to $\frac{1}{100}$ of a second. The tests were conducted across the bus bars of the switchboard of the Camden Horse R. R. Co., Camden, N. J. Average voltage 515 volts. Before throwing a fuse in circuit, a water rheostat was set, using a Weston ammeter for this purpose, so that the current desired would flow through the fuse, when the circuit was completed by the traveler on the trackway.

The different fuse wires were subject to the following limitations: The time of the traveler running full length on the trackway 1.5 seconds; the current ranging from 20 to 180 amperes in 10 ampere steps. The smaller fuse wires would fuse with the minimum current of 20 amperes, and in all instances inside of the 1.5 arc limit; but in the larger size wires, a greater current was required to fuse the wires in the 1.5 second limitation.

In order to strike an average, the tests were repeated under similar conditions as regards current and gauge wire with a 3" horizontal fuse, a 6" vertical fuse, both of which were connected to a standard form of fuse block, also a $4\frac{1}{2}$ " fuse, the average in length of the 3" and 6" was employed connected in a specially constructed fuse block, which absolutely prevented any arcing of the terminals.

The results gave, therefore, the time required in fractions of a second for the circuit to be opened under identically similar conditions as regards current and gauge of wire for a 3", a 6" unprotected and a $4\frac{1}{2}$ " protected terminal fuse. The time required to open a protected terminal fuse wire becomes less and less as current increases and grows less regularly, showing that a regular law is followed. The curve is an hyperbola having its asymptotes for its axes, and the equation for it is $xy=18$ for No. 28 copper wire, whereas, the two unprotected terminal fuses are uncertain and show in a very pronounced manner wherein the terminals contribute to this end. The conclusion one is forced to draw is that a fuse wire in practice, when it fuses, does not do as it was intended to, open the circuit, but establishes a condition, though the time may be limited, wherein the terminals act as a magazine to furnish the gas through which the circuit is continued.

The conclusions drawn from the tests and the general literature upon the subject of fuses, are as follows:

First.—The proper and only fuse block to be used is one having protected terminals.

Second.—That fuse blocks should be furnished so that the terminals would not be burned under conditions approaching an absolute short circuit across the bus bars of a 500 volt power station.

Third.—That magnetic cut-outs are immeasurably preferable under all circumstances.

1. London Electrical Review.

2. Elec. Engr. May 16, 1894.

1. Abstract of a paper read before the American Street Railway Association, Atlanta, Ga., Oct. 27-19, 1894.

ELECTRIC TRANSPORTATION DEPARTMENT.

THE MAMMOTH WESTINGHOUSE RAILWAY GENERATORS IN PHILADELPHIA, PA.

AMONG the large contracts which have been awarded to the Westinghouse Electric Mfg. Company in the past year, the one for the Philadelphia Traction Company calls for 12,750 H. P., divided into six machines of 1,500 H. P. each, and five of 750 H. P. At present, two of the larger machines are in full operation at the company's Mt. Vernon street station, while another



FIGS. 1 AND 2.

one is in course of erection; in the Sutherland avenue power house one 750 H. P. generator is doing its regular day's work, and one more is now being erected. The rest of the machines are still in course of construction and rapidly nearing completion. A few words concerning the arrangement and design of these machines will serve to explain the accompanying views of the generators and their parts.

The field casting is separated in a vertical line and rests upon slides upon its bed-plate, so that in case of accident to the armature, the two halves can be separated and the armature exposed for repair without disturbing the engine in the least. The 10 pole field casting, is designed according to Westinghouse practice, with laminated pole pieces. These are built of sheet iron punchings, held together with riveted end-plates, the whole being cast into the massive cast iron yoke.

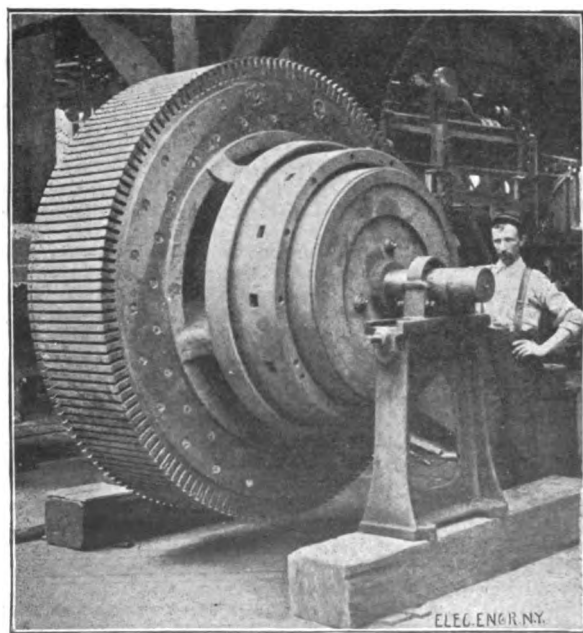


FIG. 3.—CORE OF 1,500 H. P. WESTINGHOUSE ARMATURE.

Thus a most effective protection against eddy currents in the poles is secured, together with perfect magnetic contact between pole and yoke. The shunt coils are wound on substantial sheet

iron bobbins, while the series or compound coil consists of a continuous strip of Lake Superior drawn copper, as shown in Fig. 1. The object in using a coil of such enormous section was to con-

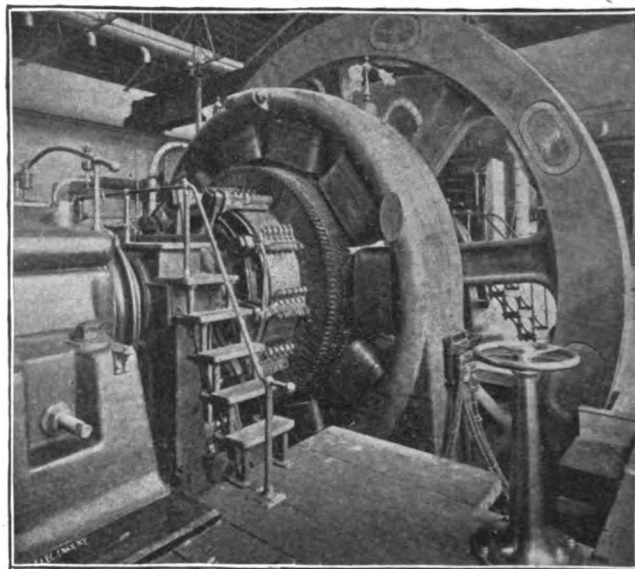


FIG. 4.—1,500 H. P. WESTINGHOUSE RAILWAY GENERATOR.

nect all the compound coils in series with the armature, so as to secure perfect magnetic balance.

If the design of the field is a radically new departure, this is even more the case in the construction of the revolving part. The slotted armature is built up as a ring, in sections of laminated sheets between two brass end plates, and securely held together by mica insulated bolts. The laminated ring is then pressed upon the cast iron hub, shown in Fig. 2, and securely keyed on. Fig. 3 shows a core of a 1,500 H. P. generator armature, finished and ready for the coils to be placed into the slots. Before being wound, this armature is pressed on the engine shaft by means of a hydraulic press.

The armature coils, are wound on lathes, in a special shape, to constitute a continuous drum winding. They are insulated in a most perfect way with mica shells, and have

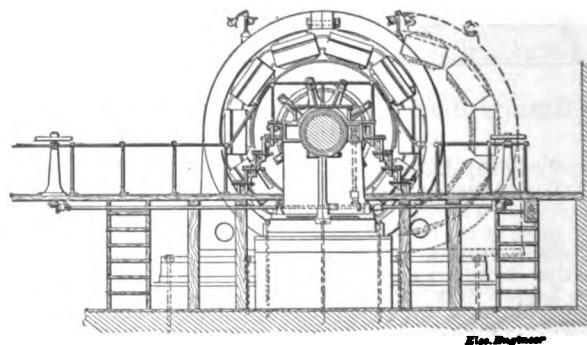


FIG. 5.—1,500 H. P. WESTINGHOUSE RAILWAY GENERATOR.

to stand an insulation test of 5,000 volts alternating current after being placed in the slots—that is, fifteen times the rated voltage of the machine. The leading advantage in this method of construction is that any given coil can readily be removed from the core without disturbing more than a few adjacent coils. No binding wires whatever are used, either on the core or on the projecting ends of the coils. The armatures in Philadelphia are wound and connected in place after being mounted on the engine shaft. The entire work for a 1,500 H. P. generator consumes but a remarkably short space of time and this method has the advantage of doing away with the risk involved in the transportation of

a completely wound armature of these dimensions. The diameter of the 1,500 H. P. armature is $7\frac{1}{4}$ feet, while its width is $22\frac{1}{4}$ inches; the 750 H. P. armature is 6 feet in diameter, and 25 inches wide.

The most difficult problem in all large machines is found in the design of the commutator. In the Philadelphia generators this has been solved, electrically as well as mechanically, in a most perfect manner. The commutators, of 4 and 5 feet diameter, are entirely built up of drop forged copper segments, insulated with pure mica. The segments are supported on a ring, making a part of the cast iron armature hub, and are clamped together by taper rings in the usual way, the only, but important, difference being that the outside ring is made in sections, so as to allow any special strip, or part of the commutator, to be removed, in case of repair, without taking the whole apart. A test of 5,000 volts alternating current was performed on these commutators.

The current is collected by carbon brushes, four and five of these, respectively, being located in each of the ten brush holder arms. The brushes are individually clamped in a light brass housing, and this is connected to the support by a flexible copper shunt, thereby doing away with all sliding or vibrating contacts

ATTACKING THE BOSTON WEST END.

The constitutionality of the law giving authority to the West End Street Railway Company of Boston to construct and operate an overhead electric system is attacked, and the matter is now pending in the Supreme Court of Massachusetts.

TROLLEY WIRE IN ITS GREAT "BOA CONSTRICTOR ACT."

A BIG crowd at Fourth street and Girard avenue last night witnessed a miraculous escape from death and at the same time saw the terrible power of the electrical current employed to run the trolley cars. A guard wire of the Girard avenue line broke and falling crossed the trolley wire and dangled downward. A. W. Salle, aged 19 years, of 2902 Lawrence street, was riding a bicycle down the avenue when suddenly he saw the wire directly before him. Realizing that it was probably heavily charged and that contact with it meant death for him, Salle threw himself headlong from his bicycle and landed unhurt. The wheel rushed

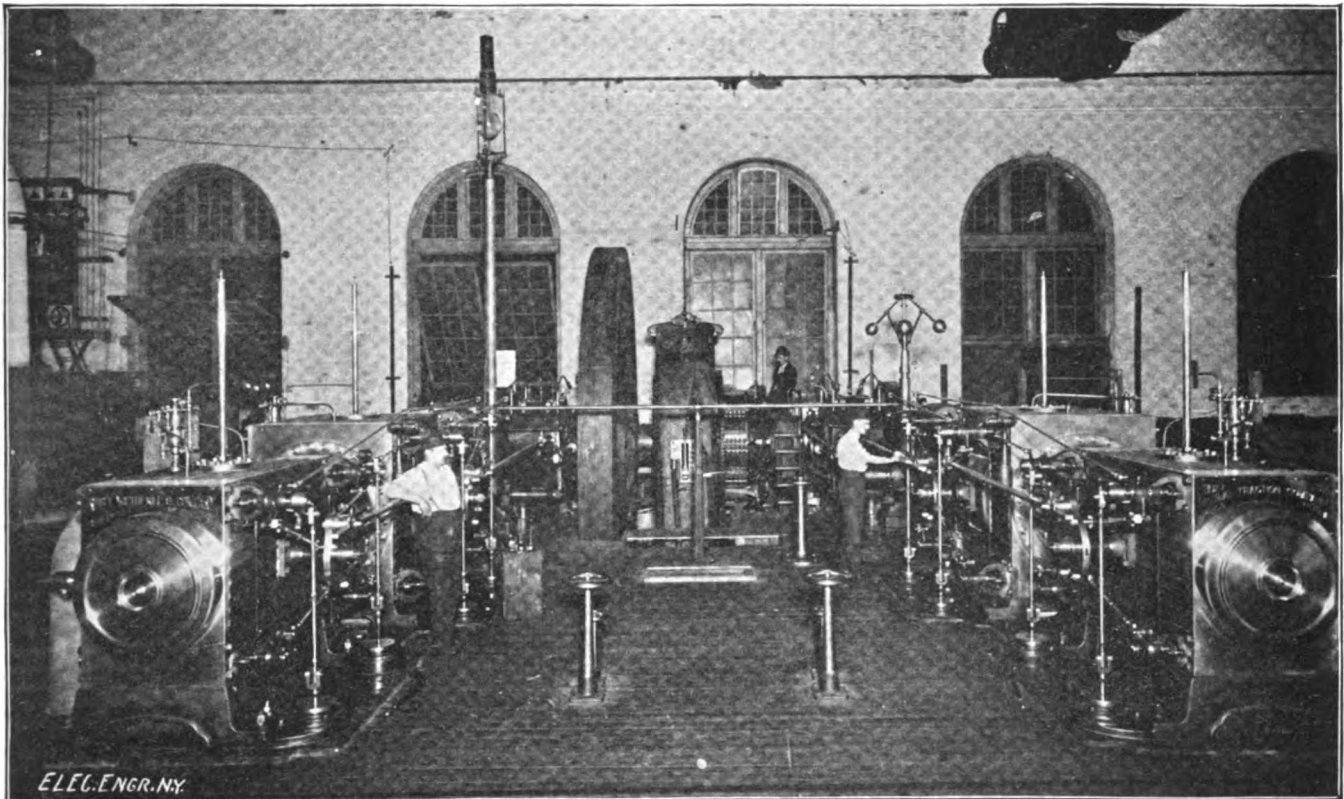


FIG. 6.—1,500 H. P. RAILWAY GENERATOR, MT. VERNON ST. POWER HOUSE, PHILADELPHIA TRACTION CO.

inside of the brush holder box. The ten arms are insulated from and fastened to the iron rocker spider, which can be revolved on its stand by means of hand wheels and worm gearing, as plainly shown in Figs. 4 and 5. Ornamental steps lead to the platform on top of the engine bearing, where access to the upper brushes can be gained.

The 1,500 H. P. generator, running at a speed of 80 revolutions per minute, will deliver 2,250 amperes at 500 volts, while the 750 H. P. generator is built for 1,125 amperes at 500 volts running at the same speed. Machines of both sizes are working daily up to their maximum capacity without signs of heating, or any unusual sparking at the brushes.

The generators are directly connected to double compound tandem Corliss engines, built by The Robert Wetherill Company, of Chester, Pa. Fig. 6 gives a view taken in the Mt. Vernon street power house, and shows the complete arrangement of engine and generator.

A number of power stations in various parts of the country are now equipped with machines of the same type in different sizes from 300 to 1,500 H. P., such as Atlanta, Ga., Indianapolis, Ind., Fairhaven, Conn., Louisville, Ky., Jersey City, N. J., and other places.

SAVANNAH (GA.) street railways have reduced fares to two rides for a cent during the cut rate war.

ahead and in a second struck the dangling wire. Like a thing of life it wound around the machine and in a few seconds the terrific current had smashed the bicycle to pieces. Workmen finally came with a tower wagon and took the deadly wire away.—*Phila. Inquirer*.

A NEW CHICAGO ELECTRIC RAILWAY.

THE LAKE SHORE ELECTRIC RAILWAY CO., Chicago, has been incorporated with a capital stock of \$10,000,000. D. H. Louderback, J. L. Cochran, Dunlap Smith and others are the incorporators, and it is generally understood that the stock is largely held by capitalists who are behind the Northwestern Elevated Road. Indeed Mr. Louderback, president of the Northwestern L., admitted such was the case, and added that the new electric lines were to be used as feeders for the Northwestern "L," much as the North Shore Electric Line is now used to attract nickels to the north division cable system. The new line will connect with the Northwestern "L" at Wilson avenue, six and one half miles from the county building in a northwesterly direction. The road will run as close to the Lake Shore as possible and take in all the towns between Chicago and Milwaukee. Preliminary surveys are now being made, and if the road is ever built, it will be the largest single electric railway system extant, the length being about 90 miles.

THE USE OF THE BOOSTER ON ELECTRIC RAILWAY CIRCUITS.¹

BY J. H. VAIL AND H. S. WYNKOOP.

Accurate tests show that the commercial efficiency of the street-railway motor at normal voltage is 78 per cent., while at two-thirds of the normal it is only 53 per cent. We all undoubtedly recognize the fact that the resultant effects of too little copper show up to the non-expert traveling public in slow speed and dimming of lamps; but to the railway company the

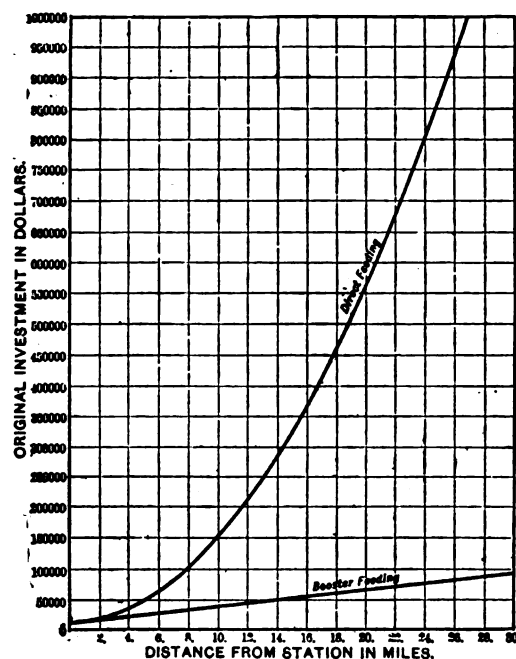


DIAGRAM I.—INITIAL COST OF STEAM AND GENERATING PLANT, COPPER AND SPECIAL APPARATUS FOR DELIVERING 200 AMPERES AT 500 VOLTS.

results are *actual losses*—decreased traffic and increased coal bill; which is the direct opposite of what we desire. In other words, instead of aiming at the greatest receipts for the least expenditure, we are actually getting least receipts for greatest expenditure.

The usual remedy suggested is: use more copper. Very good. But if the owners of the road are already groaning under the weight of the copper mine that has been saddled upon them, together with the cash invested therein; if they live in constant fear that they will be forced to place all feed wires in large cities underground, what then?

The well-known booster system, invented by Mr. W. S. Barstow, and applied by him with great success to the feeders of constant potential electric lighting plants covering large areas, is worthy of our careful investigation, as it promises to offer a practical aid to the economic solution of what may be called the medium long distance electric railway problem.

With direct feeding we can overcome the loss in transmitting energy only by incurring the heavy cost of copper as a first investment. With the booster system, we overcome the loss in transmission by incurring the cost of operation of a machine which shall automatically raise the initial voltage above that of the bus bars by an amount which may exactly equal the drop in potential on the feeder at that instant.

When using this machine, we calculate our feeder for ampere capacity only, and constantly maintain the pressure at the service end of the feeder equal to the pressure at the bus bars, irrespective of the length of the feeder or the load.

In any given instance, the cost of a direct feeder increases the square of the distance, while the cost of the booster feeder is directly proportional to the number of miles. These characteristics of the latter system result in a reduction of first cost of from 25 to 75 per cent. as compared with the first cost of the ordinary direct feeding methods of our present practice; and it thereby becomes possible for numerous electric street-railway companies to extend their lines into suburban localities from ten to twenty miles distant from the power station, at the same time retaining the investment within reasonable limits.

Diagram I. shows that for distances greater than one and one-

half miles it will cost less to install a booster system than to place copper and machinery in the usual manner for feeding direct. In cases where motive power is water, costing little or nothing per H. P., these curves give at once the relative economy of the two methods; but ordinarily on account of the consumption of coal, the loss in the line (represented in the new method by the power required to operate the booster) becomes an important factor in the discussion; and it is necessary to establish equations for the operating expenses, taking into account the fixed charges of interest and depreciation on the investment, as well as the cost of furnishing the required power.

An inspection of this diagram shows at once the immense superiority of the booster system over direct feeding in cases where first cost is the essential feature. It will be noted that the curves have been carried out for the entire thirty miles, without regard to the practical voltage limit in direct current machines, or the point at which the cost of operating an independent station becomes less than operating from the main station.

Referring to Diagram II. the intersection of the upper curve with the upper straight line is the point at which the booster system costs as much to operate as does the direct system. This distance we find to be twelve and one-half miles. For shorter distances, direct feeding is more economical, while for longer distances the booster system has an absolute advantage. Corresponding curves for $\frac{3}{4}$, $\frac{1}{2}$ and $\frac{1}{4}$ load, and the resultant curves are shown on Diagram II., in order to afford ready means of comparison.

A careful study of these diagrams demonstrates in what the economy of the booster system consists. While the method we have outlined may seem like robbing Peter to pay Paul, it must be remembered that in direct feeding there is a large amount of capital invested in the pole line, accruing interest day and night, in storm and sunshine, irrespective of the traffic on the line; while with booster feeding, the interest on copper investment is nominal, the power required to drive the booster itself being proportional to the load on the line. Thus we can readily understand why, under the conditions given, with an average load of one-quarter the maximum, the booster system is absolutely more economical than the direct feeding system for distances over four and one-half miles.

It has been impossible to represent results derived under varying conditions without multiplying the diagrams indefinitely. All calculations have been based upon the most recent methods of rail bonding and track feeding; and the assumption that the resistance of the return circuit is equal to that of the outgoing circuit is therefore perfectly safe.

It may occur to some that the installation of a special high

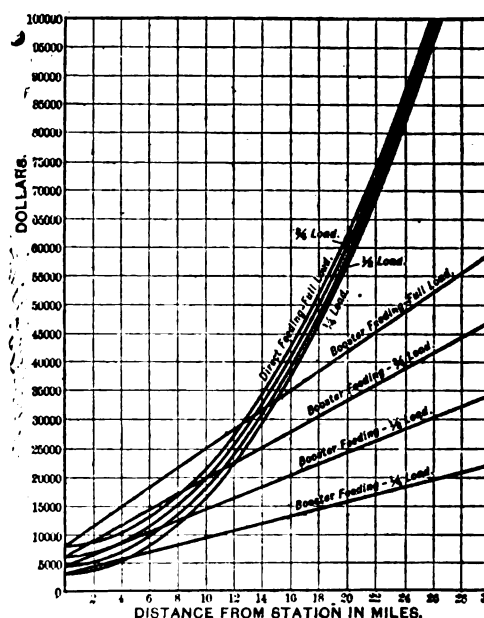


DIAGRAM II.—OPERATING EXPENSES OF PLANT DELIVERING 200 AMPERES AT 500 VOLTS, INCLUDING COAL, OIL, WASTE, WATER, LABOR; AND INTEREST AND DEPRECIATION ON THE INVESTMENT.

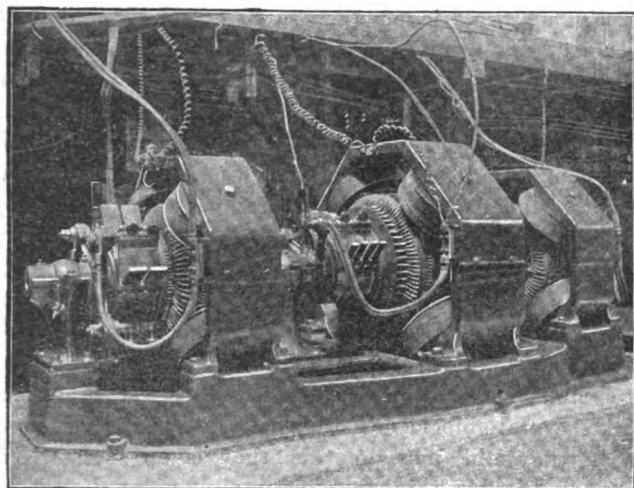
voltage generator to supply the feeder in question would be a simpler method of reducing the copper; but a cognizance of the enormous variations in drop under extreme changes in load, on a long feeder calculated for ampere capacity only, leads at once to the discarding of such a scheme until such time as manufacturers can furnish efficient generators overcompounded from 50 to 150 per cent.

Ordinarily in calculating copper for distribution, we are

1. Abstract of a paper read before the American Street Railway Association, Atlanta, Ga., Oct. 17, 1894.

obliged to allow for special features influencing traffic, such as ball grounds, race tracks, picnic groves, etc. As there is seldom any necessity for bunching cars at all these points simultaneously, and as the various features are usually scattered, it follows that at all times one or more of the feeders is lying comparatively idle. Under the plan suggested, the copper is figured for average conditions and a booster, placed in the station, is arranged to be thrown immediately upon any feeder which may become burdened with an excessive load.

Another feature of this system which makes for economy becomes prominent on long suburban lines forced to run an infrequent schedule late at night. On such a road the booster may be shut down and cut out of circuit entirely when the load on the



DOUBLE BOOSTER, OPERATING TWO FEEDERS.

long distance feeder drops to, say, one quarter of the maximum, depending upon the amount of copper in the line.

If this suburban line extends to a park or pavilion which is open only during the summer months, the advantage of the booster over direct feeding is enormous, since the investment on a booster lying idle is a small fractional part of the interest on the idle copper of a direct feeder.

On many roads already in operation the copper in the line has proven entirely insufficient, and the erection of additional feeders is contemplated. Would it not be worth while to consider the installation of a booster at one-tenth the cost of the extra copper, provided calculations showed the economy of operating the two systems to be equal?

In the progress of electric railways, as in the growth of cities, development frequently fails to follow the lines predicted for it. It therefore happens that many a road to-day is worrying along, the victim of misplaced judgment—and copper. In many instances the adoption of a booster, and a re-distribution of the present copper, will remedy the evil in the most economical manner.

In large cities such as Boston, Brooklyn and Philadelphia the tons of copper could in this way be largely reduced, with a gain at the same time in uniformity of pressure.

MAIL, EXPRESS AND FREIGHT SERVICE ON STREET RAILWAY CARS.¹

BY RICHARD MC CULLOCH.

It is manifestly impossible, to lay down any fixed rule for mail, express or freight service—to say that it should be put into practice on street railroads or that it should not be put into practice. This is a problem which must be solved for each railroad individually. In this paper it is intended merely to give a general discussion of the question without attempting to solve it.

In order to ascertain as well as possible how much has already been done, a circular asking for information in regard to mail, express and freight service was sent to every street railroad company in North America. Nine hundred and seventy-eight letters were sent out and four hundred and thirteen replies were received. These replies are tabulated below. As a great many railroads were not heard from it cannot be assumed that the table is absolutely correct, but it is probable that most of the railroads having such a service answered the circular. Roads which are enumerated as having express or freight service are only those which have this service fully developed. The carrying of packages by con-

ductors of passenger cars was not called express service, but is enumerated in a separate column. From some of the states, notably Pennsylvania, Rhode Island and Massachusetts, it was reported that the transportation of express and freight by street railroads was prohibited by state law, and many of the roads answered that their franchises allowed only the transportation of passengers.

The rate charged on express matter was usually five or ten cents per package, while the freight rates vary from four to ten cents per one hundred pounds. The mail is usually carried either under a direct contract with the Government or under a sub-contract with a mail contractor. The income from the transportation of the mails varies according to the amount of mail, the number of trips per day, and the length of the haul, from \$100 to \$1,000 per annum.

TABLE OF MAIL, EXPRESS, AND FREIGHT SERVICES IN NORTH AMERICA.

	Any form of Such Service.	Under Contract with Express Co. or U.S. Government.	Haul Steam R. R. Freight Cars Over Street R. R. Tracks.	Operate Special Cars for this Service.	Carry Small Bundles on Passenger Cars for Pay.	Contemplate Such Service.	Distribute Matter Beyond Station.	Use Combination Express and Passenger Car.
Mail.....	62	58	.....	5	.....	10	.....	.....
Express.....	25	8	.....	9	31	7	2	8
Freight.....	55	.....	6	27	.....	12	2	.....

Mail Service.—That the street railroads of this country are already alive to the possibilities of the mail service is shown by the table. Sixty-two street railroads are now carrying Uncle Sam's mail, while fifty-eight have Government contracts. Most of these railways are suburban roads or roads joining towns; but the postal authorities realizing the advantage of quick delivery and collection, are now beginning to make arrangements with the large city systems for transportation of the mails from main post-offices to branches and for distribution and collection throughout the city.

The only method of handling a large mail service, in which it is necessary to collect and distribute along the route, and handle it satisfactorily both to the patrons of the road and the post-office department, seems to be in the use of a separate car—an independent mail car in charge of a railway mail clerk. This system is already in use on street railroads in St. Louis, Brooklyn and several other places, and so far as we can learn is giving excellent satisfaction, both to the railway companies and the post-office authorities.

The report then describes the method of handling the mail and the operation of the U. S. Mail Car on the St. Louis and Suburban Railway.

The question as to whether or not mail service is called for depends almost entirely upon local conditions,—the length of the road, the territory through which it runs, the proximity of depots and post offices to the line of the road, and many others. An advantage in estimating the advisability of inaugurating a mail service, is that a certain, fixed income may be assumed, which is not the case with any other service. It is usual in Government contracts to pay a certain sum per one hundred pounds per mile, the weight being determined at stated intervals by weighing the mail. For this reason, a certain fixed income is assured during the interval. A number of cases may be cited in which it would be well for the managers to look into the profits which might accrue from a mail service. Large city systems covering various parts of the city and passing close to post offices and public buildings would afford great advantages in distributing and collecting the mails. Suburban roads, roads connecting towns, and roads running to depots in the outskirts of the city are other instances of openings for mail service.

An advantage, independent of any financial return, and one which is regarded by many as the one reason for street railways embarking in this service, lies in the prestige of Uncle Sam's name. This point was never so thoroughly illustrated as in the late labor troubles in Chicago. Rioters may have no fear of the city police or of the State militia, both of whom are often entirely in sympathy with them, but they regard with the greatest awe a company of regulars armed with Springfield rifles.

Express and Freight Service.—The answers to the circulars showed that thirty-five roads are now engaged in the express business, while fifty-five are hauling freight. As a matter of fact, however, few roads through the country are doing a regular

1. Abstract of a report presented at the Meeting of the American Street Railway Assoc., Atlanta, Ga., Oct. 17, 18 and 19, 1894.

THE ELECTRICAL ENGINEER.

(INCORPORATED)
PUBLISHED EVERY WEDNESDAY AT
203 Broadway, New York.

Telephone: 1323 Cortlandt. Cable Address: LENGINEER.

Gmo. M. PHELPS, President. F. R. COLVIN, Treas. and Business Manager.

Edited by
T. COMMERFORD MARTIN and JOSEPH WETZLER.
Associate Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue,
Boston, Mass.

Western Editor and Manager, C. KAMMEYER, 1439 Monadnock Building, Chicago,
Ill.

New York Representative, 203 Broadway, } W. F. HAWES.
Philadelphia Representative, 916 Betz Building, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada, - - - - -	per annum, \$3.00
Four or more Copies, in Clubs (each) - - - - -	2.50
Great Britain and other Foreign Countries within the Postal Union " - - - - -	5.00
Single Copies, - - - - -	.10

[Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1893.]

EDITORIAL ANNOUNCEMENTS.

Addresses.—Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of THE ELECTRICAL ENGINEER. Communications for the attention of the editors should be addressed, EDITOR OF THE ELECTRICAL ENGINEER, 203 Broadway, New York City.

Communications suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.

Advertisements.—We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers.

VOL. XVIII. NEW YORK, OCTOBER 24, 1894. No. 338.

CONTENTS.

EDITORIALS :—	PAGE
The Street Railway Convention.....	334
Carbon as a Coherer.....	335
ARTICLES :—	
Hertzian Waves, Carbon Microphones and "Coherers." (Illustr.).....	336
Electrical Machinist Practice.—VI. (Illustr.).....	336
Magnetic Leakage in Dynamo Electric Machinery.—VII. (Illustr.).....	337
The Hermitic High Tension Electrolyzer (Illustr.).....	339
Destructive Arcing of 500 Volt Fuses.....	339
The Use of the Booster on Electric Railway Circuits (Illustr.).....	339
Mail, Express and Freight Service on Street Railway Cars.....	339
Power Brakes vs. Hand Brakes.....	339
Thirteenth Annual Convention of the American Street Railway Association.....	339
Exhibit and Convention Notes.....	339
City and Suburban Electric Railways.....	343
Taxation.....	344
TRANSPORTATION DEPARTMENT :—	
The Mammoth Westinghouse Railway Generators in Philadelphia, Pa. (Illustr.).....	339
Attacking the Boston West End.—Trolley Wire in Its Great "Boa Constrictor Act."—A New Chicago Electric Railway.....	331
LITERATURE :—	
"Steam; Its Generation and Use".....	337
SOCIETY AND CLUB NOTES :—	
American Institute of Electrical Engineers.....	345
Brooklyn Institute of Arts and Sciences.....	345
REPORTS OF COMPANIES :—	
Street Railway Earnings.....	345
INVENTORS' RECORD :—	
Classified Digest of U. S. Electrical Patents Issued October 9, 1894.....	346
TRADE NOTES AND NOVELTIES AND MECHANICAL DEPARTMENT :—	
Large Rushmore Projector—The Light of the Future—Another Big Power User for Niagara.....	346
The Phoenix Telephone (Illustr.)—Hubley Mfg. Co.—General Electric Co. gets Gedney Channel Contract.—Siemens & Halske Electric Co.—La Roche Won It.—Watertown Engines.—Ball Engines.—G. E. Copper Snap Knife Switch (Illustr.).....	347
Harrisburg Engines.—Electric Light and Power House Equipment.—New York Notes.—Western Notes.—New England Notes.....	348

THE STREET RAILWAY CONVENTION.

IT will be seen from the contents of this issue that the Atlanta meeting of the American Street Railway Association was one of great interest and importance. Everything in the industry that counts for progress has become electrical, and the whole growth of the business will now lie along the line of electrical development. The engrossing nature of electricity is seen from the papers read, the discussions, the exhibits and the attendance. As a result of all this, the Association is going very rapidly through an evolutionary process that makes some of its methods appear antiquated and useless. The prevalent system of treating topics in "reports," for example, is not at all a satisfactory one, while the handling of the work is little short of disgraceful. We have never seen the time of a convention more shamefully wasted than it was at Atlanta. There seemed to be no regular time of meeting, people could not be got together owing to the distances to travel, and when they were caught, it was to squander hours in taking incomplete group photographs. That such was the case was due largely to the poor arrangements made by the local committee. It was impossible for people to travel nearly 12 miles and walk several blocks each day to attend the sessions, or if they did not do this they could scratch for a sandwich lunch in the dusty and noisy Exposition Hall. Within the meeting room, with its open windows, bare floor, and adjoining exhibits, the noise was often frightful, and hearing was generally difficult. We have no hesitation in saying that one or two such wretchedly arranged and mismanaged conventions would wreck the Association entirely and lead to a radical reorganization. This is not merely our own opinion but that of a majority of those who watched the performance through. For many people, the visit to a charming Southern city was sadly spoiled. The local hospitality was all that could be wished, but conditions were much against its enjoyment. We are glad to note the preliminary plan of enlarging the sphere of the Association, but it must be remembered that the constitutional amendments will not go into operation for two years.

It was a noteworthy feature that the attendance of Southern men was large. They have never before attended in a body, but their interest in all that was going forward was another evidence of the strong new sap now welling through every portion of the South, and manifesting itself in a prosperity which for the present no other section can equal. There are already many electrical roads in the South, and it is certain that after this convention there will be more. We only trust that our Southern friends will not run away with the idea that electricity can do miracles. It can't. Some roads are hopeless with any motive power. But we believe that in a great many instances and particularly in the cities of smaller population, of which the South has many, it would be found wise, convenient and profitable to combine the local electric lighting and electric railway plants. Even then the economy may not be as great as some fondly imagine, but it will at least be a first step towards securing greater efficiency and profit. Our conviction is that one of the great developments of the near future is in this direction,

and our electric lighting and electric railway readers alike should give it their careful attention.

One or two features of the exhibits were quite striking. The Genett air and Sperry magnetic brakes were easily in the lead as meritorious novelties one or both of which must soon be found on every street railway in the country. Public opinion demands better braking, and it is right. Our street cars are very defective in this respect, and there is no longer any excuse for not placing in the hands of the hardworked motorman such improved methods of swift control. It was interesting also to see the candidacy for favor on the part of a new comer, the Walker Co., whose apparatus was a centre of interest; while of great current interest and importance was the Card equipment for interurban and cross country travel now chiefly handled by steam roads. The Sperry single motor to the car was not perhaps a novel equipment, but its obvious ease of working forces conviction that that type of construction is on right lines and may yet be a large factor in the business.

The figures brought out in the Report of the Committee on "Mail, Express and Freight Service" are somewhat in the nature of a revelation and cannot fail to attract the immediate attention of those who have not already undertaken this class of work. Where the State law or the character of the franchise does not prohibit the doing of a freight and express business the results show a profit in this class of business which some enthusiasts, not without justification, maintain, will eventually lead to the displacement of the present city express and delivery wagons. Even where immediate direct profit can not be discerned, the report very properly points out the advertisement which a road receives by operating an express service, and the aid which it renders in building up outlying districts which must eventually act as feeders to the road.

The paper read by Messrs. J. H. Vail and H. S. Wynkoop at the Atlanta Convention of the American Street Railway Association is an extremely timely one and should be carefully studied by all electric railway managers. Beginning with a brief but comprehensive review of the conditions existing to-day on the average electric railway, the writers touch lightly upon alternating and motor-converter systems of distribution, take up a theoretical discussion of the booster system, and finally assume a number of operating conditions, under which the booster might be economically called upon to play an important part. A very interesting pair of diagrams has been compiled, furnishing comparisons between the two systems under the assumption that it is desired to deliver 200 amperes at 500 volts. Messrs. Vail and Wynkoop dispose of the question of specially wound, high voltage generators for use on long distance feeders by calling attention to the fact that in such a case it would be necessary to over-compound the machine from 50 to 150 per cent. Present practice limits itself to about 15 per cent. over-compounding, but we believe that manufacturers of dynamo electric machinery would not be found wanting in meeting a demand of this nature whenever it shall be manifested. Though apparently neglected in the field for which it was primarily intended we are glad to note the appreciation and application of the booster in a department of electrical work in which, we are convinced, it will

find immediate and spontaneous acceptance owing to the crying needs for just such a system. It is safe to say that there is scarcely an electric road in operation to-day whose capacity is not taxed beyond the limits of its original design, or, in other words, in which the drop at the farther end of the road due to insufficient feeder capacity is not anywhere from 25 to 50 per cent. On the other hand with the standard of electric railway potential now in use, limits of operation are imposed much in the same way that the low potential lighting stations have found themselves hampered. Operating, like the latter, at a fixed potential, our large electric railway systems have heretofore been obliged to string enormous conductors to get a working potential at the distant ends of their lines and even then relief has not always been obtained. We are glad to note, therefore, the introduction of the booster system in railway work on the electric road now rapidly nearing completion at Poughkeepsie, N. Y. It is the consideration of such problems as are advanced in the paper that points to the broader views now gaining acceptance in this class of work. Important as it is in city and suburban railway work it is all the more to be considered in the installation of the numerous roads now joining adjacent smaller towns together and with the larger cities, and especially those roads whose paralleling of steam roads has already made their influence felt in the abandonment of various local trains.

The appointment of a committee to investigate and report on the validity of patented articles used in railway work seems to point to a doubt on the part of the members of the Association of the justice of the demands often made upon them by the manufacturing companies. The work of such a committee, however, if it is to have any value whatever will require investigations involving an expenditure of time and money, which the Association may hardly be prepared to meet at this time. Even after such a report is finished, it will require the Courts to pass definitely upon the questions involved, so that unless the Association is prepared to back up its report by some offensive and defensive alliance among its members the committee's work will be practically lost. It may be added that the steam railroads of the country already have such a committee, which is understood to serve its purpose fairly well.

CARBON AS A COHERER.

DR. LODGE's recent lecture on Hertz and his work was largely devoted to the description of the various devices for detecting the presence of Hertzian waves and among these the Lodge coherer was not the least interesting. In his original lecture Dr. Lodge denied the cohering property of carbon though in a subsequent reprint he credits Prof. Fitzgerald with having noted the phenomenon with that substance also. As confirmatory of the Fitzgerald evidence we publish in this issue a highly interesting account of the experiments of the eminent electro-therapeutist, Dr. Wm. J. Morton. The influence of the disruptive static discharge on the resistance of a carbon rheostat was found to be so great as to necessitate its abandonment in Dr. Morton's practice when the static machine is operated. There can therefore be no further question that carbon must be classed among the coherers and the phenomenon observed may have to be taken into consideration in other applications of carbon. Dr. Morton also throws out a significant suggestion as to the actions which may influence carbon microphones and cites his experiment to show that forces other than pressure cause variation of resistance in some types of microphone.

(Continued from page 333.)

freight business, most of the so-called freight services partaking more of the nature of express. As operated upon street railways, the distinction between express and light freight service is so ill-defined that it is deemed best to consider both subjects together.

There are many points in the street railroad as now conducted which make it almost an ideal agent for the transportation of packages and light freight. The great number of points reached by the cars, the absolute certainty with which they run, the thousand and one precautions taken against any stoppage of however short a duration, the rapidity with which distant points are reached, and many other causes combine to make the street railroad of to-day a common carrier of exceptional advantages, when only short distances are considered. Many conditions will suggest themselves to railway managers in which an express or freight service may be made a paying institution. In the case of a town in which the railway station is some distance from the business part of the town, there can be no quicker, safer and better plan of conveying express and freight to some distributing point in the heart of the town than by the street railroad. Whether or not this will pay depends upon the amount of material, the competition, the distance, and the scope of the street railway franchise. A case often met with through the country is that of two towns connected by an electric railroad, one of which, having no steam railroad, is obliged to get all its supplies through the other town. The installation of a freight service of some kind would at once suggest itself in this case, and the profits would depend upon the size of the towns, the character and occupations of the inhabitants, the distance between the towns, etc.

The operation of an express service on large city systems has not been attempted to any great extent, but it has been contended by some enthusiasts on the subject that a street car express service will eventually take the place of the many city deliveries and city express wagons now in use. As an example of a city road operating an express and freight service involving collection and a house to house delivery, the report cites the case of the Southern Railway of St. Louis, which has been operating an express service on this plan for almost two years. The railway company assumes all the responsibilities of a common carrier, holding itself liable for all loss and damages. This, however, is a contingency which seldom occurs. It is well patronized both by the residents along the line and the large retail stores in the centre of the city. It does not interfere with the regular running of the cars, and since its inauguration has never failed to pay.

Up to this point we have considered an express and freight service merely as a paying or non-paying institution, to be adopted in the one case and to be rejected in the other. There is another view which may be taken of the case, however, which is in many instances the most proper solution of the problem. This is to regard the establishment of this service merely as an auxiliary to the passenger traffic, to be operated whether or not it pays in order to gain increased passenger travel. The most notable instances of this sort are the roads which run from the hearts of our large cities out into the suburbs. It is manifestly to the interest of these roads to promote building and settlement along their lines, and how can they better attract builders than by giving their patrons all the advantages of city life, not only in furnishing them with rapid transportation to and from the city, but in aiding them in receiving their provisions and supplies. This calls for some form of express service, and although the receipts from this source may not equal the expenses, the increased passenger receipts and the advertisement given the road must also be taken into account.

In all street railroad practice, the cardinal point of any service, whether mail, freight or express, must be that it does not interfere in the least with the passenger travel, and this point should always be kept in view in the arrangement of such service. For this reason we would strongly advocate the use of separate cars, operated by separate motive power and by separate men. In roads between towns, or suburban roads operated on the same plan as a steam railroad, where stops are made only at certain stations, a combination car or trailer might be used; but in city roads the system of piling trunks and boxes in the passenger cars and on the front platform, and stopping for these to be put on and taken off, is not of the era of the electric railway.

If mail bags may be thrown on the front platform of a car, carried to their destination and delivered without causing any long stops, this is the best way of solving a mail service on a small scale; but in freight or express service it is better that the work should be done with cars especially devoted to such service and by men especially trained for it.

The report also describes the ambulance or hospital car now being built for the St. Louis roads intended to convey patients from the Dispensary to the city and other hospitals.

Information received from several of the states, as before stated, shows that in some places the transportation of freight or express over street railroad tracks is prohibited by state law or municipal ordinance, and it has been suggested that associations

of managers of street railroads in those states be formed, for the purpose of securing favorable legislation.

In closing, it would perhaps be well to note some of the principal points which, it is hoped, have been brought out in this paper:

1. That a mail service involving collection and distribution is best handled on a separate car, operated on the same plan as a U. S. Railway Mail Car.
2. That it is supposed that a great advantage arising from the transportation of the mails comes from the fact that the road is under the protection of the Government, and is thus secure from riots, strikes and blockades.
3. That the most promising opening for an express or freight service is a road running between two towns, or a city road running through well-populated suburbs.
4. That the question, whether or not such a service will pay is entirely a local question, and must be estimated for each road separately, under existing conditions.
5. That there are cases when it would be advisable to operate such a service, independent of the profits, in order to accommodate the patrons of the road and to induce building along the line of the road.
6. That such a service operated upon the ordinary street railroad must not be allowed to interfere in the least with the passenger traffic.
7. That in states having laws prohibiting this service, associations of railway managers should be formed to secure favorable legislation.

POWER-BRAKES VS. HAND-BRAKES.¹

BY E. J. WESSELS.

The braking power on an electric or cable car should be so positive as to admit of stopping in less than the car's length, if necessary. Recognizing the inadequacy of a single hand-brake on grades, many roads have provided a duplicate inside equipment. This extra equipment is additionally expensive, not only in first cost, but especially in maintenance.

A motorman realizes how difficult it is to keep his car under control, hence he sets one brake before the car starts down grade. He then depends upon his other brake. Manifestly when one brake is set from start to finish, it means wear and tear of apparatus and short life for the shoes. Moreover, the speed of car is needlessly retarded and fewer car miles per day can be run than would be made if he had a positive braking outfit at command.

In a good air brake the brake cylinder is constructed of iron and contains a piston and piston rod, which is attached to brake levers under the car. The rear end of the brake cylinder is made air tight, and connected with the train pipe, so that when air is applied from the reservoir it forces out the piston in the cylinder and sets the brakes.

The power of the brake cylinder can be easily calculated, and is equal to the square inch area of the piston multiplied by the air pressure carried in the reservoir.

Friction (or continuous) brakes operated from the axle have been used for years on cable systems, and the jar from them has caused constant complaint. On electric cars friction brakes of course can not be used. The braking force requisite to bring a car or train to a stop, should never exceed the weight of load resting upon the wheels to which brakes are applied. Any power applied in excess of this is wasteful and dangerous. The full power of a friction brake depends upon the load carried on axle to which friction discs are attached. For example, with a grip car and passengers weighing 8,000 pounds, the weight being equally divided between two axles, leaves 4,000 pounds carried by the axle with friction discs. With car wheels of two and one-half times the diameter of friction drum, we gain that much leverage, which, multiplied by 4,000 pounds, gives the direct pull power of friction brake of 10,000 pounds.

Nor is this all. The brake levers of street cars are as a rule adjusted to about four and one-half times leverage. If, then, we multiply the 10,000 pounds pull of friction brake by this leverage we have a strain of 45,000 pounds upon brake beam and shoes. This is vastly more power than is ever required. When two or more cars are coupled together it is impossible to regulate brake chains and brake gear so that every shoe will press with equal force against the wheel. When, therefore, a gripman applies his friction brake, the entire 45,000 pounds is carried by the beam and shoe that are adjusted nearest the wheels and the remaining wheels revolve without noticeable check.

In a train of three four wheeled cars with passengers, weighing 36,000 pounds, resting on twelve wheels, a brake power of say 2,900 pounds applied to each wheel would make the most perfect stop. If the entire 45,000 pounds power of friction brake is applied to only two wheels of such train, there will be 38,000 pounds more power exerted than necessary to stop the wheels from revolving, and at the same time only one-sixth effectual braking power is obtained as compared with braking pressure distributed against every wheel under the train. Such harsh, rigid, excessive power of friction brake, applied quickly by the momentum of the whole train, will wear out any kind of brake gear, no matter how good or how strongly made, and the constant jar adversely affects the life of cars. In cold, wet and stormy weather (with

1. Abstract of a paper read before the American Street Railway Association, Atlanta, Ga., Oct. 17, 18, and 19, 1894.

slippery tracks), when the grip-car is abandoned except by the gripman, the pull power of friction-drum is greatly reduced just at the time it is most needed to set brakes on trailers, which are always over-crowded at such time.

A twenty-eight foot electric-car weighing without passengers 20,000 pounds and running at ten miles per hour, has over six times the energy to overcome when brakes are applied, that a horse car has, weighing one-fourth as much and traveling at less than one-half the speed. Moreover, when horses were employed there were ten feet extra length in which to stop the car. This extra length is no longer available since the advent of electric cars. Unless cars have proper brakes high speeds are most dangerous.

Without entering the humane feature of braking, it cannot be denied that at best hand-braking is a great task for even strong men and it is unnecessary to multiply instances where hand-brakes have shown radical defects. Probably seventy-five per cent. of recorded accidents is chargeable to inefficient brakes. Statistics of this sort are hard to tabulate, and some records show even a higher percentage. While hand-brakes often stop cars quickly, they do so by consuming excessive energy. This means waste and increases maintenance account. Then, too, it is impossible for a motorman to maintain his maximum strength for a long time. In active service he has to apply brakes between 250 and 400 times daily. He can only exert his maximum strength spasmodically and temporarily, even when aided by the weight of his body.

It is a menace to life and property to have a high speed motor at work without having suitable power to control it. Thus far "reversing" has not proved a success, and, while theoretically one motor acts as a generator to drive the other (if there be two, which is not always the case), in practice this has proved a failure. The danger of relying upon the same current which propels a car to stop it too, is only too apparent. If the current fails to work in one case, how can it be expected to work in another? The trolley may run off, or there may be a break in the line when current is needed for braking a car plunging down grade. It's the unexpected that happens.

Hand-brakes have no emergency-stops. Air-brakes have, and, if necessary, stops can be made so quickly as to apply brake shoes instantly to every wheel on one car or a train of cars, in the most effectual manner. No hand-brake can do this. When hand brakes are used it is necessary to have a separate brakeman for each trailer. When an air brake is used, these extra men are entirely dispensed with.

Air brakes are provided with reserve power stored in reservoirs, and, by having large enough capacity, the air pressure required for braking becomes practically inexhaustible. The air pump of a thoroughly good air brake is most economical in operation. It requires no power when the car is starting or when it climbs grades. As it takes ten times the power to start a car that it takes to stop it going, the advantage of this is obvious. A good air brake is so compact that very little room is required for it under the car body. It has no cumbersome or complicated machinery to get out of order. It works automatically. It needs much less attention than an electric motor gets. It is only necessary to keep the mechanism clean and in order, and to lubricate the pump regularly. No hinges or springs annoy inspectors or employees. A good air brake pump, the moment it has compressed sufficient air, cuts out and runs in free air with the axle. A good air brake entirely replaces a hand brake. The hand brake may be left on the car, and the air brake can be so attached as to leave the hand brake available should it be required. A good air brake requires no expert to operate it.

One type of air brake equipment in service enables a gripman with but a small handle to work grip and brake either simultaneously or independently. When this type brake is used on a car, grip and brake levers are entirely removed, giving more space for passengers on platforms. Through its use, what formerly involved painfully hard work, is now accomplished with ease. This device is in successful operation on car 421 of the Third Avenue Railroad, New York.

The author then took up the subject of electric brakes, which, he said, combined valuable features with decided disadvantages. He quoted largely from Mr. Sperry's paper, "The Electric Brake in Practice," read before the American Institute of Electrical Engineers, and took up seriatim its arguments against air brakes as follows:

1. Mr. Sperry speaks of the certainty of an electric-brake in operating.

So is a good air brake certain in operation.

2. "The enormous power and under perfect control."

A good air brake has much more power, more constant power, and is under better control.

3. "The absence of all power absorption at moneyed cost from the central station."

This may be true if brake shoes are not used, but remains to be proved in daily service. Shoes probably will continue to be used. A good air brake consumes very little power. You can test how little by watching the readings on a car operated at this time with an air brake on the Atlanta Consolidated Road.

4. "Its high efficiency, being far superior to compressed air;

amply proven in numberless instances where electricity has replaced air. (The air requires a direct application of energy, amounting to an immense aggregate power absorption during the day from the central station; the working parts of the air machinery are attached to the car axles and require a large quantity of energy not only while compressing, but at other times as well)."

We are unaware of a single case where electricity has replaced air. We are informed on high authority that air compressors for driving rock drills and coal cutters so greatly outnumber electrical machinery for such purposes that hundreds of air compressors are sold for every drill or cutter sold. The statement that an air brake requires a large quantity of energy not only while compressing, but at other times as well, is wholly inaccurate and entirely incapable of proof. A good air pump requires no perceptible power after it cuts out.

5. "Its extreme simplicity."

So is a good air brake very simple.

6. "Observed saving in wheels, two or three fold."

A good air brake properly applied saves the wheels.

7. "Saving of brakeshoes."

We believe brakeshoes will be retained, and would not care to ride on a car without them. Under certain conditions the paper admits handbrakes will be needed. How can handbrakes be applied without shoes?

8. "Very little wear of either wheel or magnet."

There is little wear to a good air-brake, and lightning plays no pranks with an air-brake, but is likely to do so with an electric brake.

9. "No hissing to frighten horses on streets."

We have yet to hear of a case where a horse was frightened by an air brake.

10. "The low E. M. F. at which it operates."

That is true of a good air brake. It is easy to test power consumption with a wattmeter, by running car with air pump, and then running car (under exactly similar conditions) with air pump detached; the slight power consumed will then appear.

11. "The ease of its application and control."

Nothing surpasses a good air brake in these respects.

12. "Conserving strength, prolonging the usefulness and life of the motormen."

This is open to question when one sees the despair of motormen when fuses melt and switches burn out. Gripman Williams, on air-brake car 421 of the Third Avenue Road, New York, (where 120 equipments are in daily operation, told the speaker, "This job is so soft, I expect some of you Wall Street fellows will come here to run cars since times are so hard."

13. "The smoothness of its operation."

Nothing can surpass the air cushioning effect of a good air brake.

14. "Cannot cause flat wheels."

A good air brake properly applied also prevents flattening of wheels.

We had no intention to refer at length to electric brakes but have felt constrained to do so because the statements we have replied to appear in the printed transactions of the American Institute of Electrical Engineers, and should not remain uncontradicted.

Lastly it must be remembered that the magnetic clutch of this electric brake has to bear on the surface of a flat disc cast upon the car wheel. This can hardly be called "ease of application," for the brake cannot be applied to the ordinary type of street car wheel. It requires a special casting to be made on one wheel on each axle. This on a large system means an additional outlay for wheels, as "extras are charged for."

The author closed by calling attention to the numerous fatal accidents that might have been prevented by the use of efficient brakes, and begged the members of the Association to give the matter serious attention.

LITERATURE.

Steam, Its Generation and Use. 28th edition. New York, 1894.

The Babcock & Wilcox Co. 182 pp. 7½ x 10½.

This admirable compilation which has gained the position of a standard text book in most of our technical schools, has been still further enlarged and may be truly said to be indispensable to every user of steam who desires to seek the greatest economy in coal consumption. It treats not only of the most approved methods of steam generation for engine driving, but also of its distribution for heating buildings and in connection with central steam heating stations. The construction and the method of handling the Babcock & Wilcox water tube boiler naturally come in for a large share of attention, and the information may be said to apply very generally to all types of boilers. The tables giving the properties of steam, value of fuels, boiler tests, etc., make the work a most handy book of reference. Translations in German and French, under the titles of "Dampf" and "La Vapeur," respectively, have also been made, rendering the work accessible to those speaking only these languages.

THIRTEENTH ANNUAL CONVENTION OF THE
AMERICAN STREET RAILWAY ASSOCIATION,
ATLANTA, OCT. 17-19.

WEDNESDAY SESSION.

WITH a magnificent attendance of about 1,000 members, supply men and visitors, the American Street Railway Association met at Atlanta on October 17, in the Exposition Building, a large hall being reserved for the purposes of the Convention just off the exhibition hall. The meeting was called to order about 11 A. M. by President Henry C. Payne, of Milwaukee. After the roll call, Governor Northern made a hearty speech of welcome. He had some neat and effective things to say about the charms and virtues of the South and asserted that her financial condition to-day was sounder than that of any other section of the country. They had in the South 1,611 miles of electric street railway completed and projected, requiring all told an investment of \$71,080,000. All this work had been done in the last six years. He was glad to see the Association because it thus stood for one of the best modern factors of business progress and the advance of civilization.

PREST. PAYNE in reply spoke gracefully of the warm hospitality that had been extended and in return invited the citizens to see for themselves all the details that entered into modern street railway work as exemplified by the exhibit in the adjoining hall.

After some routine business PRESIDENT PAYNE then read his address, in the course of which he said:

It is hardly necessary to say that since our last meeting the street railway business has suffered, in common with all other enterprises, owing to the financial stringency and business depression which has prevailed in all parts of the country. These conditions, however, have not been without lasting benefit to the interests which we represent; I think we have all studied more thoroughly to bring about economies in operation, to limit construction of new lines into unproductive territory, and in every way to bring our business to a more healthy basis; so that from that point of view there is compensation for the depression through which we have passed.

I presume it is the common experience of all that we are on the up grade and I confidently anticipate a slow but gradual return to normal business conditions. The resources and characteristics of the American people are such that they cannot long continue in a state of either mental or financial depression.

During the transition period from animal to electric power on the tramways of our country it was but natural that the proceedings of the annual meetings of the association should be largely taken up with the consideration of the application of electricity to transportation purposes. Now that we may fairly consider such application as an accomplished fact, I think our attention should to a greater degree be turned to a comparison of views regarding the practical operation of our several roads.

The substitution of electricity for animal power has elevated the business to a higher plane. Street railways have become as essential to the prosperity of our metropolitan cities as the steam railways to the country at large. Having had practical experience in the management of both these methods of transportation, I can fairly say that the duties of the manager of a street railway equipped for rapid transit are more vexatious than, and require quite as much ability, intelligence and application as those of one in charge of a steam railway. The steam railway manager makes his time tables, publishes them, and the people are expected to, and do suit their convenience to the same. Not so with us. We are expected to make our time tables conform to the convenience of each individual separate passenger who desires to be transported, and a car is expected to be at each and every corner at the identical moment when the passenger is ready to be carried. Again, the steam railway manager has to encounter legislatures and legislation but once in two years, and at the most once in each year, and that during a short period in the winter only; while the life of the street railway manager is made unhappy, to say the least, by the legislative bodies in cities, which are practically in continuous session.

The American capitalist is quick to discover promising fields for the investment of capital, and I think it is safe to say that never in the history of our country has there been a more rapid development than has come from the application of electricity to transportation purposes. In the anxiety to secure franchises and to reconstruct street railways, very excessive valuations have been placed upon and paid for the right to operate by electricity in our large cities. This has led the representatives of the people to believe that there is a present value attached to franchises far beyond that which the facts will sustain.

Consequently these conditions have led to a fruitful field for the legislator as well as for the assessor, from whose tender solicitude for the welfare of the people the street railways, whose prosperity contributes so much to the general good, have suffered.

The interest, as well as the inclination of most managers tends toward giving as liberal and good a service to the public as the patronage will justify.

Transfers and to what extent they should be granted, commutation and its effects upon earning, and the relative earnings of cars operated on long and short time headway, furnish fruitful topics for discussion and comparison of views. These and many other practical subjects which will occur to you, I think should receive your attention, and I believe their consideration will be not only of great interest but of material advantage to us all.

The question of insurance has become a perplexing one. In many instances the larger systems find it very difficult to obtain insurance in sufficient amounts to cover their risks, and I think the common experience is that rates have increased to such an extent as to be so burdensome as to justify us in considering the propriety of organizing a mutual insurance association.

He closed by referring in eloquent terms to the death of the veteran street railway man, Mr. W. J. Richardson, of Brooklyn, and that of Mr. W. J. Stephenson, of Washington.

MR. J. B. PARSONS then read by deputy his paper on "The Best Method of Treating Accidents and Complaints."

In the discussion that followed, the feeling was general that a line is never treated fairly by a jury, no matter what the justice of its case. No sufficient remedy seemed available, however. It may be noted that the motorman was dubbed "motorneer" by some of the members.

MR. H. L. BETTIS then read by deputy his paper on "A Standard Form for Accounts for Street Railways."

The report of the treasurer showed the Association to be in a prosperous and solid condition. SECRETARY RICHARDSON also presented a report from the Executive Committee, which spoke highly of the work being done by the technical press and commended in particular that of Mr. C. B. Fairchild, who through the *Street Railway Journal* had done so much to promote the welfare of the industry and the Association.

Invitations were accepted from the Chattanooga Electric Co. to visit that city and Lookout Mountain, and from Mr. H. T. Edgar, of the Georgia Electric Co., of Atlanta, to visit their fine central station in Atlanta. The meeting then adjourned.

In the evening the members attended a reception given them at the Capital City Club.

THURSDAY SESSION.

An Executive Session was held on Thursday morning, by order of the Executive Committee.

The subject of Transfers and Commutations was discussed, the general impression being that the privileges should not be extended further than is absolutely necessary.

The subject of the formation of a street railway Mutual Fire Insurance Co. was also taken up, and on motion of Mr. Russell P. Harrison the incoming officers and executive committee were appointed a Committee to report on the subject.

On motion of Mr. Littell of New Orleans, Messrs. Littell, Perrine and Connette were appointed a committee to wait upon the officers of the Underwriters Association of the South, with a view to securing better conditions and rates for insurance of street railway properties, the office of the Association being in Atlanta. The Executive session was then adjourned.

The following gentlemen were appointed a committee to nominate officers and select a place for the next meeting: Messrs. McLean, Connette, McNamara, Baumhoff, Breed, Semmes and Rugg. Letters inviting the Association to hold its meeting in their respective cities were presented in behalf of Cincinnati, O., Philadelphia, Pa.; and the invitation extended at the Milwaukee meeting by Mr. Lusher of Montreal for the Association to hold its meeting in that city for 1895 was read by the Secretary.

THE EXECUTIVE COMMITTEE report commented upon the business depression which has existed, and said: "The fact is there is no more accurate test or measure of the state of the business of the country than the varying income of a street-railway company, showing with absolute accuracy the state of business activity or depression in the community. Business in general during the last year has been bad, and the street railway business in particular has suffered, several of our member-companies having gone into the hands of receivers, while consolidation still continues to be the trend of the times. While the year has been a hard one, the business outlook is encouraging, and we look forward with confidence to a successful year's business."

The report enumerated a number of changes which had taken place in the membership; the present number being 184 companies, exclusive of additions at the Atlanta meeting.

Reference was made to the special reports to be presented as covering a wide range of subjects, and expressing the latest thought and practice in the business; and the Committee touched upon the subject of the Exposition of street-railway supplies, which was fast becoming a prominent feature. A list of judicial decisions published during the year was given, and it was stated that the second volume of "American Street Railway Decisions" would be issued to subscribers during November.

A proposed amendment to the Constitution submitted provided for the admission of individuals, and companies, not street railways, as associate members, under certain conditions; such character of membership having been found conducive to the general

welfare of kindred associations. A proposed amendment to the By-Laws had in view morning sessions only; providing for less exhaustive meetings; for more opportunity for social enjoyment, as well as for opportunity to examine the display at the Exposition, which had become so important a feature of the annual meetings. If the foregoing amendments were adopted, there would be two classes of membership—associate and active; and the meetings would open on Tuesday and continue for four days.

Invitations came from certain companies and individuals inviting the Association to visit Cincinnati, Philadelphia and Montreal. The question was referred to a committee.

MR. JOEL HURT, president of the Atlanta Consolidated Co., presented an interesting report on "The Feasibility of the 'T' Rail on Paved Streets." His paper gave a list of twenty-six cities using such rail, while it was stated that fifty other companies might have reported. The situation was summed up as follows: "The general consensus of opinion of the 26 roads and of the officials of the cities in which they run, is that if you can once get down a hundred yards of T rail and make a decent job of the paving, neither the officials nor the citizens will permit you to use anything else in the future. The main thing is to make your paving job a neat and clean one."

MR. RICHARD McCULLOCH then presented the report of the committee on "Mail, Express and Freight Service on Street Railway Cars."¹

FRIDAY'S SESSION.

President Payne called the meeting to order at 10.30, a. m. The first business was the report of the Committee on City and Suburban Electric Railways.

A letter from MR. O. T. CROSBY was read, regretting his inability, owing to pressure of business, to present a report on "Standards for Electric Street Railways." The Committee was continued.

H. K. BOWEN, Superintendent of the Chicago City Railway, recommending that a Committee be appointed to investigate the subject of the validity of patented articles used by street railways.

The Special Committee appointed to interview the representative of the Underwriters' Association of the South reported that they had been unsuccessful in their efforts.

This was followed by a paper on T rail construction in Terre Haute, read by its author, MR. RUSSELL B. HARRISON (son of ex-President Harrison).

After the reading several questions were asked.

A stray invitation for the Association to visit Minneapolis was read and turned down.

The following proposed amendments to the constitution were submitted in the following terms by the secretary:

Article III. of the constitution, shall be amended, so as to read as follows:

Section 1. There shall be two classes of members—active and associate.

Section 2. Active members shall be American street-railway companies, or lessees, or individual owners of street-railways; and each member shall be entitled to one vote by a delegate presenting proper credentials.

Section 3. Associate members shall be individuals or firms, or companies, not embraced in section 2, who have been recommended by an active member. Associate members shall not be entitled to vote.

Article VII. of by-laws shall be amended by the substitution of the word "Tuesday" for "Wednesday" and by the addition of the following words to the first sentence, namely, "and shall continue four days."

Naturally there was considerable discussion on the amendments, which were finally accepted, but which must be ratified at another convention to be binding.

MR. BROPHY, of Boston, representing the Mutual Insurance Association of New Bedford, was introduced, and said that it would be better for each State Association of Railways to make application to the board of underwriters of the mutual companies which control its territory. They had been insuring electric light stations and power houses for two years, and car houses for one year. They had at the present time \$7,000,000 of property of this class, and for the last ten or twelve months, ending October, their losses had been twenty-three hundred dollars on the seven millions. They had been able to pay a dividend of seventy per cent. on business written one year ago. They had been insuring this character of property for two years, which showed that the electric business was not so hazardous as some people thought. (Applause.) They had paid to their policy holders forty per cent. of the premiums paid, the premiums collected having paid losses and expenses, and left a balance to be returned to the policy holders.

On motion of MR. RUSSELL B. HARRISON a special committee of five on Mutual Insurance was appointed as follows: Russell B. Harrison; A. Dyer; L. Perrine, J. W. Baumhoff and Mr. Lusher.

MR. PERRINE offered the following:

RESOLVED, That the Executive Committee is hereby requested to take under consideration the question of the enlargement of the field and scope of the Association, and submit a plan suggesting ways and means therefor, at the next meeting of the Association.

The Nominating Committee presented the following report: President, Joel Hurt, Atlanta, Ga.; 1st Vice-President, W. Worth Bean, St. Joseph, Mich.; 2nd Vice-President, John M.

Cunningham, Boston, Mass.; 3d Vice-President, Russell B. Harrison, Terre Haute, Ind.; Secretary and Treasurer, William J. Richardson, Brooklyn, N. Y. Executive Committee: Henry C. Payne, Milwaukee, Wis.; W. H. Jackson, Nashville, Tenn.; D. G. Hamilton, St. Louis, Mo.; G. C. Cunningham, Montreal, Canada; J. N. Partridge, Brooklyn, N. Y.

The Committee recommended Montreal, Canada, for the next meeting.

On motion, MR. PENNINGTON, of Chicago, was instructed to cast a ballot of the Association for the officers nominated.

The Report of the "Committee on Transfers and Commutation" was read by title.

The report of the Committee on "The Use of the Booster on Electric Railway Circuits,"² after a few remarks giving the substance of the report, was ordered to be printed in the proceedings:

MR. HURT the newly elected president was then escorted to the Chair and made a brief address.

On motion of MR. PERRINE a vote of thanks was passed to the retiring officers; the Atlanta Consolidated Street Railway Company; the Capital City Club; the local press, and the citizens generally of the City of Atlanta, generally, for the courtesies, kindness and attention, and generous hospitality, which had been extended to the Association.

The report on "Destructive Arcing of Five Hundred Volt Fuses," was read by title only.³

The report on "Brake-Shoes," was read by title only.

MR. DAVIS moved that a Committee be appointed, to consist of two members of the Association, and one manufacturer, to investigate the subject of the adoption of a standard style of brake-shoes, conduct experiments, and to report the data collected, and its conclusions at the next meeting, without expense to the Association. Carried.

The report on "Power Brakes vs. Hand Brakes," by Mr. E. J. WESSELS, was read by title.⁴

MR. E. A. SPERRY discussed the report and disagreed with it in a number of particulars.

The special paper by MR. ALLEN R. FOOTE, on "Taxation,"⁴ was then read by title.

The meeting then adjourned.

EXHIBIT AND CONVENTION NOTES.

MR. P. C. ACKERMAN was present in the interests of the of the American Electrical Works.

MORRIS, TASKER & Co., of Philadelphia, builders of electric railway poles were represented by Messrs. Flanders and Wheeler.

MR. R. W. HOLLIS, of 80 Peachtree street, Atlanta, exhibited an automatic motor starter for elevator work. It was in operation and drew considerable attention.

THE GRAHAM EQUIPMENT Co. of Providence, exhibited one of their trucks. They have several in use on the Atlanta Traction Co.'s line.

THE ROCHESTER CAR WHEEL WORKS of Rochester, N. Y., had a neat selection of their wheel accompanied by a neat selection of representatives in Messrs. F. D. Russell and G. C. Morse.

THE NEW HAVEN CAR REGISTER Co. had a most attractive exhibit, and choice souvenirs ranging from paper weights to grandfather clocks were distributed by Messrs. Boyd and Bradley.

JACKSON & SHARP, the Wilmington car builders, not only had representatives on the ground, but had several cars conspicuously labeled, patrolling the streets all day and night.

THE STANDARD UNDERGROUND CABLE Co. were represented by Mr. F. E. Degenhardt who has much of their Southern trade in charge and who as a change from giving away several miles of samples, circulated a little journal called "Infinity," from whose bright sallies the alleged comic papers might take many points.

THE OKONITE Co. were represented by Capt. W. L. Candee, who could point to the large amount of underground cable, etc., placed by his company in Atlanta, and who therefore refrained from retail reiteration of the merits of what a local paper chose to dub the "Akonite" products.

MR. CHAS. A. SCHIEREN JR., represented the belting firm of the same name. The souvenir given out by him was a tasteful pocket book ornamented with celluloid over covers, on one of which was a pretty engraving of their large Dixie tannery at Bristol, Tennessee.

MR. W. A. STADELMAN had are markably good, though small, exhibit of the beautiful manufactures of the Niles Tool Works, of Hamilton, O. It really consisted of three tools, one a special

1. See page 333.

1. See page 333.
2. See page 336.

2. See page 339.
4. See page 344.

compact lathe for street car shops, a wheel boring machine with miniature crane attachment and a powerful hydrostatic press for pressing car wheels on and off their axles and for performing other work requiring the detachment of shafts, etc.

THE BALL & WOOD ENGINE CO. had on the ground their well-known New York representative, Mr. C. R. Vincent.

THE SOUTHERN ELECTRICAL WORKS of Atlanta were conspicuous with a large sign signifying their ability to carry out repair work on armatures, etc.

THE ELECTRICAL & MECHANICAL ENGINEERING & TRADING CO. of New York were represented by Messrs. J. H. Vail, president, and W. H. Brenner. Copies of the former's paper on his direct current booster system were distributed. The company is beginning to do a large amount of first class electric railway construction.

THE WESTERN TELEPHONE CO. made a neat exhibit of their magneto telephones, and of their "modern" and compact exchange switchboard. Visitors were freely allowed to test the efficiency of the apparatus and sheets of testimonials were circulated as to its satisfactory operation.

THE WALLACE ELECTRIC CO., of Chicago made an effective use of their electric railway literature dealing with their specialties, such as Wood's line hangers, pull overs, bridge and barn insulators, adjustable switches, cross overs &c., W. W. lightning arresters, Robinson trolley wheels, "Brilliak" railway lamps, Habirshaw wires, &c.

THE STORM MFG. CO., of Newark, N. J., and J. H. Graham & Co., of N. Y., made through Mr. C. A. Hoagland a neat exhibit of the "H. & C." sleet cutting trolley wheel. It already has the endorsement of large use, and should be found a great help during winter. In fact testimonials are quoted from some companies to the effect that they could not have operated without it last winter.

THE STILLWELL BIERCE & SMITH-VAILE CO. made through Mr. J. W. Taylor, their Southern agent, a very fine exhibit, including the Stillwell heater, Smith-Vaile pumps, railroad track jacks, Victor turbines, Worrall patent friction clutches. The Consolidated Co. of Atlanta has recently put in 1,000 H. P. of Smith-Vaile air pumps and condensers in connection with their Rankin & Fritch engine.

THE CONSOLIDATED CAR HEATING CO. of Albany, N. Y. made a very interesting exhibit, in operation, of their various forms of electric car heaters, for all classes of roads. These heaters are most snug and compact, and are of quite handsome design. The company distributed some clever pamphlets and were represented by Mr. J. F. McElroy, their engineer, and Messrs. N. H. Ransom and E. A. Smith.

THE CENTRAL ELECTRIC HEATING CO. made a fine exhibit of their apparatus for electric heating etc., and were adequately represented by Mr. E. B. Wyman, who has made a special study of the problems connected with car heating and has given out some most valuable data on that important question.

THE LEWIS & FOWLER MFG. CO. were to the fore with a well selected exhibit in the hands of Messrs. George Whipp and other members of its staff. The exhibit included street railway supplies, registers, stoves, car trimmings, etc. The company also reported a large number of orders for snow sweepers in cities outside the Southland.

THE EDDY ELECTRIC MFG. CO. were present in the person of Mr. M. D. Baird, and their exhibit was made for them by the Atlanta Traction Co. in whose station two 110 K. W. Eddy generators have been in satisfactory operation for some 9 months. The sturdy build of the Eddy generators qualifies them very specially for the hard work of railway plants. Mr. Baird, reported also that a large amount of the Eddy stationary motors had also been installed in Atlanta, some 75 to 100 H. P. being used in a variety of industries.

THE FULTON TRUCK AND FOUNDRY CO. of Mansfield, O., had a good exhibit. They were represented by W. E. Haycox, president and general manager; W. Hazelton, 3rd, and others. The exhibit included their Imperial trucks, Troy sand boxes, hydraulic motor lift, Haycox patent door fastener, Robinson patent drawbar, standard transfer table and numerous other specialties. One novel piece was a machine run by a small Elliot-Lincoln motor, destroying used tickets at the rate of 2,000 per minute.

THE CHAPMAN VALVE CO. were represented by E. L. Ross, mechanical engineer, who showed one or two choice samples of their beautiful work, now so well known and so largely used in electric railway and lighting plants. A special circular was also distributed relative to valves for plants carrying 125 to 250 pounds pressure and for superheated steam. These are built with a removable bronze seat with extra heavy shell.

THE GEORGIA EQUIPMENT CO., were on their native heath—or cotton—and made a very neat show. They were represented by J. T. Voss, C. E. Fairbanks and W. Brooks. They showed a line

of Beacon incandescent lamps, the Allen line material, Interior Conduit, switches sockets, &c., and a very useful new insulating cloth and paper, made by the Empire Electric Insulation Co. The cloth is made for armatures, paper for field coils, tape for motors, slots, &c. Samples were freely distributed which street railway men were invited to try for themselves.

THE HEINE SAFETY BOILER CO. of St. Louis circulated folders illustrative of their boiler and giving a list of several large plants equipped with their boiler for street railway work. Col. Meier was on the ground.

THE PAIGE IRON WORKS of Chicago had a very fine exhibit, right down the centre of the hall, of their girder and T-rails. There was a section of track on steel ties, using suspension joints, in brick pavement, after the manner of the track in use at Terre Haute, Ind. A. W. Paige and E. S. Nethercut were in charge.

THE BASS FOUNDRY AND MACHINE WORKS, of Fort Wayne, showed, in care of Mr. P. L. Leach, a fine range of street car wheels in chilled cast iron and steel tired, as well as axles in hammered iron and hammered steel.

THE A. A. CRAWFORD MFG. CO. of Pittsburgh, showed several varieties of their automatic fenders for trolley cars, the operation of which was witnessed with undisguised interest by many street railway men. The company has delivered over 2,500 of their pick-up and wheel guard fenders since January. Mr. Crawford has been at work on safety appliances since 1890, and has something of real merit to offer.

THE ABENDROTH & ROOT MFG. CO. were represented by their general agent, Mr. P. M. McLaren, who made no exhibit, but cited large railway plants where their boilers are in use and who circulated the Information Pamphlet No. 8, in which the subject of boilers is dealt with pithily but exhaustively.

THE STIRLING CO. were represented by Mr. T. Deegan, one of their prominent officials, who showed in active operation a neat little model of the Stirling boiler, illustrating its rapid circulation, its method of taking in feed water, its delivery of dry steam, its great accessibility to working parts, and other features. The Stirling Co., it will be remembered, received recently from the West Side Co. in Chicago one of the largest orders ever placed in this line.

THE MATHER ELECTRIC CO. were represented by Mr. T. C. Perkins, of New York, the vice president; and Mr. J. Holt Gates, their western agent from Chicago. The Company is now building a very high class multipolar 100 K. W. railway generator and is also placing on the market its new type of "Manchester" slow speed motor. The Mather apparatus under the new regime has made amazing headway.

THE OHIO BRASS CO., of Mansfield, O., issued as a souvenir of the Convention a most tasteful and ornate brochure illustrative of their goods. A better début it is hard to recall, and it would be equally hard to find a line of trolley and motor supplies that have met more favor in the eyes of the street railway people. There was no text but a modest little introduction, this being followed by several pages of their apparatus, the cuts shown in colored ink. The goods were also set forth in some detail in separate leaflets, such, for instance, as their railway motor bearings, their Spillman trolley ear, and their Wood's flexible pole bracket. Mr. King and others exhibited the goods.

THE H. W. JOHNS CO. had one of the most "fancy" and picturesque exhibits in the place, inclusive of asbestos helmets for firemen who picnic inside furnaces and boots for tourists in the heart of volcanoes. These dainty trifles while they helped draw an admiring crowd were but incidental to a really fine and large display of molded mica trolley line specialties, weather proof articles, vulcabeston spools, commutator rings, etc., and a large variety of asbestos pipe and boiler coverings. To clinch the argument in each case, special literature was ready, and should that fail, the company had in reserve the rhetorical and engineering talent of Messrs. W. F. D. Crane, H. G. Isertel, and J. W. Perry, besides H. Luscomb and E. B. Hatch of the Johns-Pratt Co.

H. J. WIGHTMAN & CO., of Scranton, made an exhibit of their material for trolley line construction and especially of their Wightman block signals for single track electric railways and crossings. The signals consist of a box containing the signal mechanism and two contact hangers located at each end of a stretch of single track. The mechanism comprises two solenoids, one connected to the "Make Hanger" for establishing, and one to the "Break Hanger," for extinguishing the signal. Within each signal box are five incandescent lamps. When the signal is in operation two of these lamps are connected in series with the three lamps in the distant box. The lighting of the two lamps on one side of the box is a signal to the motorman that the track is clear and that he has the right of way. The appearance of three lights in the opposite half of the signal box indicates that a car is approaching from the opposite direction and that the track is blocked. The small plungers within the solenoids are the only movable parts of the entire mechanism. The passage of the trolley wheel by the "Make" and "Break" hangers estab-

lishes an electrical circuit which energizes either one or the other of these magnets, thus driving up the plunger and either breaking or making the signal connection. The four signal hangers practically displace as many ordinary double pull-off hangers.

THE MEAKER MFG. Co. showed among other things their new mechanical clips for trolley wires.

THE ARBEL ESTABLISHMENT, French makers of car wheels were represented by Mr. W. Hazelton 3rd, who had blue prints with him illustrative of their celebrated product and a section of wheel.

THE MCGUIRE MFG. Co. were represented by Messrs. McGuire and Cooke, whose intentions as to a fine exhibit of their well-known trucks for trolley cars, air brakes, snow plow and sweeper, etc., were badly frustrated by the slowness of the delivery of their goods.

THE LEDERLE-TAYLOR Co. hydraulic and electrical engineers of 21 South Forsyth Street, Atlanta, took the opportunity of meeting their professional brethren. They are actively engaged in the construction of electrical plants and water works and the utilization of water powers.

THE SPERRY ELECTRIC Co. had a car running on the streets equipped with their excellent single motor system and fitted with the Sperry magnetic brakes about which so much has recently appeared in these pages. Mr. Sperry was present to explain the modus operandi of his system and was assisted by Mr. L. H. Rogers and others.

THE NEW YORK INSULATED WIRE Co. were represented by Mr. J. W. Godfrey, who made a flying trip from Chicago and St. Louis to be on hand. Mr. Godfrey states that their factory is full of orders, although he would be glad to see prices pick up. In his opinion there never has been a better time than the present for purchases of insulated wire.

MR. C. H. BARROWS, of Willimantic, Conn., distributed circulars as to the Barrows elevated and surface railway system now being installed by the Randallstown, Granite & Harrisonville Rapid Transit Co. It embodies a reversal to the old style of sprocket chain construction. The sprocket chains encircle the large driving drums of the driving wheels and pass over pinions on the armature shafts, the motor being central between the four wheels.

THE WESTON ELECTRICAL INSTRUMENT Co. were represented by Mr. R. O. Heinrich, who had with him a very pointed and pithy pamphlet discussing the advantages of the Weston permanent magnet type of instruments in power plants, and giving some most curious and startling figures as to the loss that goes on in a station using "soft iron" instruments. Mr. Heinrich did not make a direct exhibit, but this was quite unnecessary as the Weston instruments were set forth in great splendor on the General Electric switchboard and one was also used by Mr. Harrington on the board used to demonstrate the value of his magnetic cut-outs.

THE J. G. BRILL Co. made as usual a superb exhibit, not only in the building but on the streets, where Brill cars and cars with Brill trucks cropped up every few minutes. Mr. Brill was on the ground in person, and in addition to his trucks showed also his electric sweeper, snow plow, and other apparatus. The Brill Co. was one of the very first in the truck department to appreciate the importance and magnitude of the coming electric railway, and has kept pace with the great growth of the industry in a most intelligent, helpful and progressive manner.

THE FIBERITE Co., manufacturers of the well known Medbery overhead material were well represented by their agents the Mason Electric Co. of Chicago, and occupied Parlor No. 24, at the Aragon Hotel. They had planned a most elaborate exhibit of their specialties, but as luck would have it an annoying delay on the road interfered with this, so that up to the end of the Convention the samples had not arrived. Mr. W. R. Mason was in attendance, and was kept busy button holing, and being button-holed by delegates who wanted information on the subject. The Medbery material has had great success wherever used, and is regarded as standard by a large number of companies.

THE WESTINGHOUSE ELECTRIC & MFG. Co. had handsome headquarters at the Aragon where they were represented by Messrs. Bragg, Stewart, Heinrichs, Zimmerman, Tompkins, Rutherford, Gordon, Wurts and others. Mr. A. J. Wurts made for the delegates some very interesting tests of his system and apparatus of lightning arrestation. During the week the large Westinghouse generators of the Consolidated Co. were started up. The more recent additions to the local company's rolling stock have also been of Westinghouse make, and the cars on the line to the suburb of Decatur—once a steam dummy road—are also Westinghouse, each car having two 30 h. p.

THE CARD ELECTRIC Co., represented by Mr. J. F. Card made a very novel and interesting exhibit. The chief feature was a large truck equipped with one 85 H. P. Card motor. The company have also a double motor equipment for interurban service.

They showed also a simple and effective series multiple controller; a device for turning commutators on a motor without unshipping it; fuse blocks, canopy switches, and other well designed apparatus from the hands of Mr. G. F. Card, electrician of the company. The ideas of the Card Co. as to interurban service and the way to handle it attracted general attention, and their modeling in a very ingenious way on the broad lines of steam railway practice shows that somebody has his thinking cap on.

THE R. D. NUTTALL Co. of Allegheny City had a very fine exhibit of their admirable and useful trolley supplies and specialties. It may be questioned whether any concern has of late years done more than they to advance the standard of this important class of work. Their exhibit told of careful study and successful treatment of the many problems involved. There were shown the Nuttall trolleys, wheels, gears, pinions, harps, etc., in steel, iron and malleable iron; supplemented by turnbuckles and other specialties. Every piece illustrated the company's firm grasp of essential principles and explained their large trade.

THE GENERAL ELECTRIC Co. had headquarters at the Kimball, and were represented by Messrs. W. Clarke, Bailey and a large staff. They had a very striking exhibit in the Exposition Hall, the central portion of which was their "Form K" generator panels for electric railways, including the circuit breakers, ammeters, voltmeters, main switches, etc., the generator panels being complemented by total current and feeder panels. Large sections were also shown of the General Electric tubing for underground railway feeders, with pole tube; and there were also "G. E. 800" motors, "K" controllers, generators, and a complete line of overhead construction material.

LINBURG, SICKEL & Co. of Trenton, N. J. made a very striking exhibit of their Trenton trolley wagon. Its strength may be gauged from the fact that a big "coon" was put on top of it and made to dance in the liveliest fashion, but it stood without a quiver. The wagon is the design of J. R. McCardell and has already gone into extensive use in such cities as Philadelphia, where more than half a dozen are in service. The wagon and tower are solidly yet handsomely built, and at the top is a swinging or revolving platform. The tower is fitted with gear which enables it to be quickly raised and lowered to any height. There are also a couple of light ladders, tool boxes, etc., and altogether the tower is one of the best ever produced for its class of work. There is no interruption of car service while it is in use, as the swinging platform carries a man clear over any passing car.

MR. C. L. CORNELL, E. E., of Hamilton, O., represented the very interesting Cornell specialties. One of these is a small arc lamp to be operated as a headlight on street cars, and fed from the trolley circuit. A soft carbon is used and the result seems to be very satisfactory, and the light is wonderfully good and steady, full provision being made to prevent jarring of the carbons or a flaming arc. Another specialty was a very simple soldering iron in two or three parts, the principle being essentially that of heating the business end by an arc between the tip of the outer shell and a brass core. The arc could be heard inside the cap. The inner rod was safeguarded by neat little sections of Steward lava insulation. Both these specialties are likely to be heard from in the near future.

PROBABLY a better display of street railway supplies was never made than the one at Atlanta last week. There may possibly have been larger, but none which included a better range of standard goods and specialties or more novelties of real merit. It is a great shame and pity therefore that the exhibit was made in the Exposition Building in Piedmont Park, two or three miles out in the suburbs with a brisk walk at the end of the trip. The meetings were held in an adjoining room, which eased matters somewhat, but a frightful amount of time that could ill be spared was wasted daily in going to and from the hotels. The local street car company mitigated the general discontent by issuing free books of car passes, but that did not restore the wasted time and energy of a host of weary men. The floor of the Exposition Hall was laid out in reserved spaces of various sizes, filled with goods or occupied by ornate booths, the whole occupying nearly 15,000 feet of floor space.

THE PENNSYLVANIA STEEL Co. did not splurge with a large exhibit, but what they did show was mighty good. The exhibit contained samples of solid cast steel special work, frogs and switches, 9-inch construction, of the most approved pattern. Their "built rail" work showed the solid and intelligent construction peculiar to this company's makes, and which has won great success for them. One very interesting piece was a steam road crossing built up from T-rail very ingeniously and satisfactorily. Their frogs and tongue switches in but one or two castings were also remarkably fine. Conspicuous in the choice exhibit were two pieces of 9-inch guard rail shorter in radial bend than any street curve the writer wots of, and showing with what nicety and accuracy the Company handles such work. They were held upright by a complete girder crossing, built up of a similar section, in but very few points. The Company's deep and heavy girder rails in which they were pioneers, say, up to 10

inches depth and 80 or 90 pounds weight, are now in large use. Philadelphia alone has perhaps 600 miles. The Company were represented by E. M. Smith, treasurer; John F. Ostrom, general agent; C. S. Clark, M. D. Pratt, and C. W. Reinohl.

FAYERWEATHER & LADEW the belting manufacturers of New York were represented by Mr. E. W. Howe.

THE PRICE RAILWAY APPLIANCE CO. exhibited the joints and rail bonds designed by Mr. J. M. Price.

THE JOHNSON STEEL RAIL CO. of Johnstown, Pa., represented by Major Evans and others had a splendid exhibit of their well known rail specialties in the various types.

THE CHAS. MUNSON BELTING CO. of Chicago had a good exhibit of their belts of the class now in extensive use in electric lighting and railway plants.

MR. E. M. CARHART of Providence, R. I., distributed circulars of his car fender, which is a screen of wire or tarred rope, concealed under the platform when not in use. The screen is shot forward at the will of the motorman. There is also a permanent screen carried before the dash board in a vertical position.

"SUGGESTIONS, RULES AND TABLES" is the title of a very handy little pocket book on electric railway work, issued by the Walker Manufacturing Co. for circulation at Atlanta. Our readers ought to secure a copy. It gives a mass of data about location, construction and operation.

THE NATIONAL ELECTRIC LIGHT ASSOCIATION was represented by its Secretary, Mr. George F. Porter, who attended with a view of studying the methods of the A. S. R. A. and of becoming acquainted with such of its members as are finding their way into the electric lighting field. The fraternal message from President Francisco was received enthusiastically.

THE CREEAGHEAD ENGINEERING CO. of Cincinnati had an admirable exhibit of their electric railway line material, including their double flexible pole bracket, single bracket, etc., for wooden or iron poles. The bracket is ingeniously contrived and of neat and solid workmanship.

THE NEW ENGLAND ENGINEERING CO., of Waterbury, Conn., had on exhibition one of their Breed's wagons for trolley line construction and repair. It is not gaudy but has a look of simple handiness that should commend it to all having work on hand. It is not a collapsing tower, but rigid, and swings on a pivot. When it is swung down it lies very compactly.

THE STEPHENSON CAR WORKS were represented by Messrs. Pugh and Tackaberry. Curiously enough, while new Stephenson cars here are now electric and cable, the export trade demands still a horse car. When the Stephenson works cease to get such orders, we shall know that the great revolution in motive power for cars has accomplished itself. The company favored their friends with handsome steel tapes for the pocket.

THE SAFETY CLUTCH BRAKE CO. of Thirty-first and Ludlow streets, Philadelphia, showed a new clutch brake for electric cars. Its peculiar ratchet feature, assisted by the strong coupled clutch bearings gives the operator control of the car all the time, the dog on the platform holding the teeth of the sprocket wheel at every turn. The brake is certainly very quick in its action and is a meritorious effort to bring a familiar method up to the exacting conditions now to be encountered.

THE JEWELL BELTING CO. were represented by Messrs. Newton and Tolles, and had a choice exhibit of their justly celebrated beltings for electrical machinery. Despite the resort to direct driven dynamos, there is still a large market for good belt, and the Jewell belt manufacturers have done much to raise the standard of quality. Besides exhibiting some fine belting, the Jewell Co. took occasion to distribute among the ladies another sample of leather that appealed very forcibly to their taste, being nothing less than a highly finished snake skin purse. It is said that one of the delegates had the curiosity to inquire the cost in a high class Atlanta jewelry store and was staggered when he came to figure up what the liberality of the Jewell Co. represented.

JOURNALISM was remarkably well represented by Messrs. McGraw, Windsor, Fairchild, Price, Greene, Collins, Powers, Sullivan, Johnston, Martin, Stump, Hunt, Tuckerman, Caldwell, Taylor, Higgins and others whose pens and pages have for years been devoted to the promotion of industries relating to street car traction. The *Street Railway Journal* had a beautiful booth. The *Street Railway Review*, *Electrical Review*, *Electrical Age*, and THE ELECTRICAL ENGINEER had modest reserved spaces. *Electricity* was on file in the parlors of the General Electric Co., and the *Electrical World* issued a characteristically modest little book reminding one of Proctor Knott's famous speech which made Duluth the centre of the universe if not indeed its first cause. The *Street Railway Gazette* had no space and no inflammatory literature, but its representative, Mr. Stump, from having been in both the electrical and the street railway fields, was of infinite service as a sort of clearing house for information and for bringing together people who ought to know each other.

WHITE & CROSBY, of New York and Baltimore, were represented by Messrs. White and Harrison. Many regrets were expressed at the absence of Mr. Crosby. The firm is very busy on a variety of heavy electrical engineering work, and has a large amount of railway construction to execute in the near future.

MR. A. S. PARTRIDGE, of St. Louis, and the Partridge Carbon Co., of Sandusky, O., had a good exhibit of their motor brushes and generator brushes, of carbon, for all systems. Mr. Partridge, superintendent, has been a carbon manufacturer for ever and a day, and now has embodied all his knowledge and experience in a reliable and standard product.

THE PECKHAM MOTOR TRUCK & WHEEL CO. was fortunate in being one of the few of the multitudinous truck companies to get its apparatus in time. At this late day, there is no need to enlarge on either the Peckham trucks or their inventor. It may be mentioned that the Sperry car exhibited had a Peckham truck. A remarkably handsome Jackson & Sharp open car plying between the hotels and the antipodal exposition grounds had a Peckham truck under it.

THE COMPLETE ELECTRIC CONSTRUCTION CO. of New York were represented by Messrs. John A. Seely and G. F. Porter. The concern has been doing a large amount of railway construction, and now has on hand, through Belden & Seely, a heavy contract at Syracuse, N. Y. Mr. Seely confessed himself as very hopeful about coming railway work, and expressed the belief that capital would soon rally to its support in a way never seen before.

MR. W. E. HARRINGTON had an excellent operative exhibit of his "C.-S." automatic magnetic cutout, made only by the Cutter Electrical Co. of Philadelphia. As a check on careless or mischievous motormen it is invaluable. One case was cited of a driver who instead of handling his brake preferred to reverse the controller. With an ordinary fuse cut out, this trick was easy of execution, but the magnetic cut out was too much for him. It opened up eleven times in a single day, and the evildoer was detected with cheering precision.

THE GENETT AIR BRAKE CO. were represented by their general manager, Mr. E. J. Wessels, who had a space neatly enclosed, in which were found a collection of parts of the air brake system, to show its modus operandi, and from which were distributed copies of the Company's new catalogue, just issued. The exhibit was not large, but it was supplemented in a most complete and effective manner by the display made of the use of the brake on two cars of the Atlanta Consolidated Co. The city has a great many hills and stiff grades, and upon these the cars demonstrated their ability very strikingly. As everyone knows, the necessity of greater control of the car under high speeds and on grades is rapidly forcing itself upon public attention, and hence the rapid adoption of the Genett brake is hardly cause for surprise, especially as the later perfected form is so admirable. The Genett Co. used originally an open style of pump. That which they now use is enclosed and double acting, and proof against the drawbacks attaching to the earlier forms, upon which it is perhaps as great an advance as that was upon the old hand and chain brakes. The reservoirs hold air pressure in reserve for from ten to fifteen effective stops without any additional supply from the compressor. These brakes are already in use in New York, Boston, Brooklyn, Buffalo, etc., and it really looks as though the street railways were in this respect about to repeat the experience and change which has made the steam railways so vastly safer and more efficient. The Genett Company's catalogue is a most interesting, fitting, and even entertaining piece of literature which every street railway man ought to read for himself.

THE MICHIGAN ELECTRIC CO. represented by Mr. Joseph E. Lockwood had a fine exhibit of their new line material, which as a sign said, was the product of practical men. This fact became evident upon even a very cursory examination. The line includes span wire hangers, single and double curve, barn, bracket and swinging hangers, overhead frogs, crossovers, plates, switches, splicing plates, etc. What may be called the heart of the new devices is the use of a split screw, stirrup-shaped clamp. The wire fits snugly into the stirrup, and when the bell is screwed down on the complete clamp, the wire is drawn up slightly, but the outside lower surface of the clamp is straight and smooth, while the grip obtained is something extraordinary. The pole line itself would pretty well break down before the wire could dissociate itself from the clamp. The other new devices are equally good and useful, being all designed both for their own durability and that of the trolley wheels and poles. Another new specialty of great interest was a trolley pole headlight. Great difficulty has been experienced in enabling passengers to distinguish at night the cars they want, and various schemes have been proposed or tried. In the present instance, as will be noted, the colored light or marked signal is not placed where other lights tend to confuse, but high above all, where it stands conspicuous and alone. A great future may be predicted for the new Michigan signal light, which is lightly attached to the trolley pole base, and which, carrying an incandescent lamp, should not need attention for months together.

THE BUCKEYE ENGINE Co. was well represented by Mr. G. A. Barnard.

THE E. S. GREELEY & Co. were represented by Mr. F. A. Magee.

THE NEW PROCESS RAW HIDE Co.'s car pinions and other specialties were represented by Mr. Vosburgh, as at other Conventions.

PETTINGELL-ANDREWS Co. were fortunate in having a street railway "old timer" like Mr. F. X. Cicott on the ground.

THE ROBINSON RADIAL TRUCK Co. was represented by Mr. W. Robinson.

MR. B. F. JONES was in attendance for the progressive electrical engineering firm of Sargent & Lundy, of Chicago.

THE TAYLOR ELECTRIC TRUCK Co. of Troy, N. Y., were represented by Mr. H. C. Willis of New York.

MR. C. J. FIELD, who has built so many miles of electric railway tracks and whose engineering skill is seen in more than one plant, attended the convention to meet his clients.

WILLIAM S. SILVER & Co. whose patent ratchet brake handles, coil and elliptic springs, etc. are well known in the art, were efficiently represented in person.

THE BAIRD ELECTRIC CONDUIT Co. of Chicago were practically the only concern submitting a conduit to the attention of the convention.

MESSRS. W. J. RICHARDSON secretary of the Association and his fidus Achates Mr. T. E. Crossman, were literally swamped with work owing to the unparalleled attendance, and were perhaps the most tired men in the whole Convention. A larger official staff is necessary.

THE BENEDIOT AND BURNHAM MANUFACTURING Co. had some remarkably live representatives on the ground, and had an excellent exhibit of their specialties now in use on so many roads all over the country, including their "Benedict" brand of feeder wire and cables, copper rail bonds, trolley wires and magnet wires. The firm were also in evidence at the Hotel Aragon.

THE BERLIN IRON BRIDGE Co., whose work has done so much to improve the construction of power houses and central stations, not only had a well furnished parlor at one of the hotels but actually went to the cost and trouble of putting up a large building in Exposition Hall illustrative of their methods and materials. It was a most valuable, interesting and instructive exhibit, and was viewed with much attention.

MR. G. L. COLGATE was present in the interests of the manufactures of the Keystone Electrical Instrument Co. for which he has become sole agent. The Keystone ammeter to whose claims Mr. Colgate drew the attention of many delegates, was illustrated and described in the last issue of THE ELECTRICAL ENGINEER. It is encouraging to record that station managers are coming more and more to the use of such instruments and are learning that it is the best possible economy to use apparatus by which they may learn what their electrical machinery is doing.

THE COLUMBIA INCANDESCENT LAMP Co. was probably the only lamp company enterprising enough to have its own representative on the ground, and it is needless to add that President J. H. Rhotenhamel was the man. A great many street railway companies are using Columbia lamps with satisfaction and the number is increasing so rapidly that Mr. Rhotenhamel felt it impossible to stay away from a convention that included so many of his friends and customers. Mr. Rhotenhamel speaks very hopefully of Southern trade, and reports an enormous growth of business in the Southern States.

THE CHATTANOOGA ELECTRIC Co. extended to the visitors returning through the Key City from the Convention, the freedom of the city, on Saturday. About 150 delegates and ladies enjoyed the hospitable care and attention of Messrs. S. W. Divine and Warner S. McCall, and in the cars went not only all over the city but up Lookout Mountain and across Missionary Ridge, inspecting closely all the great battlefields in the vicinity. From Lookout Mountain, 2,800 feet high, they viewed the fair territory of three States, and they took dinner at the beautiful Lookout Inn. The street railway system of Chattanooga includes 50 miles of track within city limits—which is doing pretty well for a town of 45,000 inhabitants.

THE D. M. STEWARD MFG. Co., of Chattanooga, Tenn., were not directly represented at the convention although some of the goods on exhibition embodied their celebrated lava insulation. But as the return trains stopped at Chattanooga, several of the delegates had the opportunity to meet the head of the house. Although he fought as a Union soldier right over the ground where his factory now stands, Mr. D. M. Steward is hale and hearty, and positively juvenile in his vigor. Although the hard times has restricted the output in some lines, Mr. Steward reports a full flow of business in others, and considerably more inquiry

for electrical parts. The factory is running at the utmost capacity, and it has become necessary to open a downtown branch. Mr. Steward has also stationed one of his sons in New York to watch the electrical, gas tip, slate pencil, crayon and other lines of trade. The *Iron Age* now quotes the Steward specialties regularly as standard in its price list.

W. R. BRIKLEY's famous "Kerite" specialties were represented by Mr. F. G. Felder, who found among the street railway men just as attentive listeners as did his predecessors when the insulation was first introduced to telegraphers a long time "befo' de wah'."

THE ATTENTIONS shown to the delegates by the local committee and other street railway men were unbounded. A variety of entertainment was provided. On Wednesday evening a reception was given at the beautiful Capital City Club, and many of the leading citizens were present with their wives and daughters. After a speech of welcome by the president of the club, dancing began and refreshments were served.

During the week the cars were free to the delegates, and carriage rides were also given. On Friday afternoon, the hospitalities closed in a typical Southern way, with a barbecue at Ponce de Leon Springs on the outskirts of the city. The refreshments provided included twenty carcasses of beef, mutton and pork, cooked whole, and many succulent dainties peculiar to the region, such as "Brunswick stew," corn pone, and the like.

THE BANQUET took place on Thursday evening at the Kimball House and was participated in by about 400 gentlemen and ladies. Mr. H. C. Payne presided. The toasts and responses were: "Our Association," C. D. Wyman; "The City of Atlanta," H. E. W. Palmer; "The Street Car as a Factor in Modern Civilization," Lewis Perrine, Jr.; "Railroads and the Law," H. Jackson; "Our Country," F. G. du Bignon; "The Technical Press," H. J. McGraw; "The Local Press," L. L. Knight; "The New South," L. C. Levy. As a whole the banquet went off very well.

THE WALKER MFG. Co., of Cleveland, represented by Messrs. Harding, Short, Baylis and others had an excellent and noteworthy exhibit of their apparatus, including their steel, spring mounted motors, car controller and new generator. Should it be claimed that the Walker machinery is a pretty complete plagiarism of that already on the market, it must be admitted that the "conveying" has been shrewdly and cleverly done by those whom hard experience has taught what to secure and what to avoid. The old features continued are those that time has approved, the new features are admirable innovations, and should win patronage for the company if it can stand the present low prices and has the ability to steer clear of the dangers that have wrecked many equally promising enterprises in the same field. The spring suspension of the "Walker" motor is about the best thing of the kind we have seen, and although a jumping negro on it did not demonstrate its quality quite as well as a load of passengers would have done, it at least proved a marked advance in design. The arrangements for getting at the inside of the motor are also good. The company showed also a multipolar generator of 250 k. w., of the familiar rounded field type. It was a good healthy machine and simple enough to sell very cheaply. In fact, it was understood, or at least whispered around, that the Walker Co.'s exhibit was bought as it stood. The series parallel controller is also simplicity itself. Of course it "solves the problem;" they all do that; but it is certainly a workmanlike job. It is to be hoped that the Walker Co. may soon get some more cars running commercially, so that the test of time and use may show whether the art has received a really valuable addition to its resources and apparatus.

CITY AND SUBURBAN ELECTRIC RAILWAYS.¹

BY E. C. FOSTER.

The committee discuss the subject from the standpoints, respectively, of finance, construction and operation. The question of primal importance was the probable earning capacity. A road should be capable of earning dividends from the start, and competing lines should be avoided except where there is business enough for both. Building on a certain location merely to keep out competition is only good practice when an opportunity exists for the proposed competing company to earn dividends from the start. Otherwise let them build the road and then buy them out at the foreclosure sale.

The kind of construction most desirable for a certain location depends, of course, entirely upon the particular condition. For roads connecting towns, the regular steam road form of construction should be employed. About 60 lb. T rail, 6x7 in. oak or chestnut ties, laid 2 ft. on centres, needle switches with lever throw, etc., would give a track that would allow a speed of forty miles an hour, making it necessary to slacken speed only for curves, and as much for switches as the overhead construction demanded, the track switches requiring no reduction of speed. Curves, in such a road, should be few, and of the longest possible radii.

1. Abstract of the Report submitted at the meeting of the American Street Railway Assoc., Atlanta, Ga., Oct. 17-19, 1894.

Where it is decided to build on country roads, a location at the side of the road is, of course, preferable. Here T rail may be laid, and the track filled with gravel, covering the ties and leaving the heads of the rails entirely exposed.

In the streets of smaller towns, where permission can be obtained, it is also desirable to lay T rail, although there is always more or less trouble maintaining the paved brow that is usually required, and consequent difficulty in plowing snow from the track, due to the shears and diggers of the plow striking the partially displaced blocks.

In city streets, and others that are paved, the girder rail seems to be the only one suitable. In order to obtain the necessary depth for paving, this rail should be nine inches deep, and should weigh about ninety pounds per yard. The frequency of the service is an important factor in determining the most economical construction for use under particular conditions, and the 9 inch girder rail ceases to become a necessity, and becomes a luxury, when the number of cars run over it daily is reduced below a certain figure. For certain places, it is at least worth while to consider relaying good tram rail, using some approved form of joint plate. The subject is certainly worthy of discussion and consideration.

Regarding equipment, the longest car that can be operated successfully on four wheels is the most desirable for the ordinary conditions. For long distance lines having heavy traffic, thirty-foot bodies, on double trucks, for box cars, and fifteen bench open bodies, on similar trucks is recommended. Where there is a sufficient demand, a combination smoking and baggage car as the trail car of a train of two, should be run.

In building a new road for short distance travel, give all curves the necessary radii for the use of seven foot wheel bases through them, and have trucks this standard. On these trucks use twenty foot box cars and ten-bench open cars, either class measuring about twenty-nine feet six inches over the buffers. As a supplement to the regular equipment of motor cars, trailers are recommended, and that they may be run economically, a power brake is necessary. To meet this demand, the air brake is being developed, and promises to fill the requirements. For convenience in attaching trailers to motor cars, automatic couplers are necessary. There are several forms of latch couplings that can be made to do the work satisfactorily. An important thing in connection with the use of trailers is the adoption of, and adherence to, a standard, that all buffers and draw-bars may be of one height, and other parts right for the proper operation of cars in trains.

For electrical equipment, it goes without saying that the modern multipolar, single reduction motors, with series-parallel controllers, are the only ones that a road can afford to use. The performance of the various equipments, now manufactured by the different companies, has been so universally satisfactory that I feel that a great deal has been accomplished in the past two years in the development of the car equipment.

I am a firm believer in the desirability of heating all cars in the North, thinking that it has a very important effect upon receipts. As much as I like the results obtained from electric heating, I hardly feel that we can depend upon this method. Our experience is that it takes from eight to twelve amperes to keep a twenty foot car comfortable, that is, forty degrees above the outside temperature. This means that it requires about as much current per hour as to propel a car four miles. For short trips, run from a car house, the hot water storage system may do. We still depend upon the stove until we can find something that we consider an improvement upon it.

It is not improbable that before long, a telephone will be considered a necessary part of the equipment of each car operated on suburban lines. It often happens that means of communication with the nearest car house, or with the starter, would save much delay, and even danger, in cases of cars disabled, or thrown off their schedule time by other causes. Either a telephone in each car, with means of plugging in on convenient poles, or 'phones, arranged at the turn-outs, in boxes, may be used. As a substitute for this arrangement, or in connection with it, a system of signals between turn-outs may be desirable, under certain conditions. By the use of lantern boxes, containing incandescent lamps, and the necessary hand or automatic switches, a simple system of signals may be devised, by means of which cars running between turn-outs on single track lines will be protected from meeting other cars.

Suburban roads work at a disadvantage compared with city roads, when the question of operating expense is considered. There are many reasons why a given number of cars can be operated for less money, within a small territory than when spread over a large area. In one of the largest car houses in the world, the Lenox Street house of the West End Street Railway Company, of Boston, two men fill all grease cups, examine and replace brushes, and inspect other parts of the motors of from one hundred and twenty to one hundred and fifty cars, daily. The other work in this house is divided up among some twenty men, including carpenters and blacksmiths, so that the average is about six cars per man. Another important disadvantage under which the suburban road labors is that of the high cost of power.

Regarding the elimination of the difference in power costs, now existing in favor of the city road, the indications are that the time is coming when it will be no longer necessary for the country road to maintain its numerous steam plants. I refer to the probable introduction of the alternating system of long distance electrical transmission into railway work. Suppose the case where it becomes necessary to distribute power for railway purposes over large areas, as on many suburban roads where several power stations are now used. With this system there need be but one main power station, which can be located at the point possessing the greatest advantages for cheap production of power. At various selected places rotary transformers may be placed, one for each section of road. These receive alternating current, over long distance lines, from the main station, and deliver it as direct current to the trolley wires, or possibly to such local feeders as may be necessary for the distribution throughout the particular section. These rotary transformers require only the same care as generators. Beside them, the only apparatus in the sub-station, needing attention, would be the circuit breakers. By this arrangement, power could be distributed to cars operating over areas of from twenty-five to fifty miles radius from one station, at cost slightly above that for distribution within the ordinary distances of present practice. I am told, that with such a system, using 6,000 volts, three phase currents, from a station located at the central point, we could supply power, by the use of three No. 0 B. & S. wires, to a road fifty miles in length, when fifty cars were being operated. The total efficiency of this transmission, neglecting the loss in the trolley wires, would be about 65 per cent. These fifty cars, on the fifty mile road, would give fifteen minute headway, with a speed of eight miles per hour. With the higher speed, that would more probably fit the conditions of such a road, the number of cars would be reduced, allowing a proportionate decrease in the size of the wires, so long as the current allowance, 20 amperes per car, was sufficient. To accomplish these same results with the present system of 600 volts would require 600 No. 0 B. & S. wires, the use of which would, of course, be impracticable.

While this system has many advantages which are sure to result in its extensive application, it has its attendant disadvantages, which must be overcome. Most important of these is the difficulty of insulating the lines. It will be evident that the adoption of the long distance transmission system will admit of the use of any suitable water power that may be located too far away to be available under the direct method of transmission.

TAXATION.¹

BY ALLEN R. FOOTE.

The author discussed the subject on general principles, appealing to moral sense, "the natural law of justice" in advocacy of methods that would tax actual property only (not evidences of ownership, such as stock certificates, etc.) and that would result in the contribution by every citizen of his proportionate share toward public expenditures. In an appendix Mr. Foote offered the following to provide a just system of taxation:

1. All charges for the support of the government and for all other public purposes are taxes.
2. All property shall be assessed for taxation at its full value in current funds. All exchangeable products upon which labor has been expended, the ownership of which is protected by law, are property. Securities representing the ownership and the value of property are not property and shall not be taxed.
3. The tax levy shall be laid at a uniform rate per cent. on the assessed value of all property for the same tax levied within the jurisdiction of the State and of each division thereof.
4. All property assessed for taxation shall be entered in the books of the tax assessor for the tax district in which it is located, in the name of the owner, user, or person having the property in charge.
5. Bills for taxes shall be made in the name of the owner, user, or person having the property in charge, as entered in the assessor's books, and the payment of the same shall be a legal payment for the full amount of the tax bill of any debt or obligation of any kind due from such person to the true owner of the property upon which the levy was made.
6. Tax bills shall be a lien upon the property on which the levy was made and may be sold for non-payment as provided by law.
7. Property shall not be taxed in any way except as herein provided. Tax assessments shall be made but once in each year and the levy for all State, county and municipal taxes shall be entered in the same bill. Charges shall not be made by State, county, municipal or other public authorities, for the support of the government or any other public purpose, except a property tax, for the right or privilege of engaging in any industry, business or vocation.
8. The legislature may exempt the whole of any class of property from taxation, but it shall not make any partial exemp-

1. Abstract of a paper presented at the Convention of the American Street Railway Association, Atlanta, Oct. 17-19, 1894.

tion by authorizing a decrease in valuation, or of the rate per cent. of a tax levy for one or more classes of property less than the unexempted whole of a class, nor shall it exempt a part of the property of any class.

9. Special assessments and tax levies may be made, in consideration for special benefits accruing from public improvements, upon all property securing an increment of value by reason of such improvements.

10. Fines may be assessed and collected for violations of law; charges may be assessed and collected for costs of courts in all legal procedures; for costs of records on all recorded instruments or documents; for all public inspections, supervision and audits; and license fees may be assessed and collected for the control of all places of public amusement; the regulation or suppression of all immoral practices; the protection of health; and the supervision of public nuisances.

11. The legislature shall not delegate the right to exercise the power of taxation for any purpose, to any political division of the State or other public authority without providing by law that the books of accounts of such division shall be kept as directed by the State Comptroller, who shall audit all such accounts annually.

SOCIETY AND CLUB NOTES.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

At the Institute meeting held in New York on Oct. 17, Prof. Houston in the chair, a paper was presented by Lieut. Samuel Reber, of Fort Riley, Kansas, on the "Theory of Two and Three Phase Motors." The paper having been printed in advance it was read by title by the Secretary and the discussion opened by Dr. M. I. Pupin. A paper was also presented by Mr. Chas. P. Steinmetz of Schenectady on the "Theory of the Synchronous Motor." Both papers were discussed by Messrs. Kennelly, Pupin and Steinmetz. Seventy members and visitors were present.

The meeting of the Chicago members of the Institute took place at the Armour Institute, and was, as usual, well attended, an audience of between 80 and 90 being present. Lieut. Samuel Rodman was elected chairman. The same papers were fully discussed, and Prof. Stine illustrated his remarks by a series of lantern slides which had been prepared, showing the elements entering into multiphase machinery. Mr. Steinmetz's paper was discussed by Messrs. M. A. Edison, H. J. Sage, Professor Stine and others. After this, Professor Owens' paper on the "Test of a Closed Coil Arc Dynamo," which had not heretofore been discussed by the Chicago members, was taken up and ably discussed by Mr. H. H. Wait of the Western Electric Co. and others. The paper by Mr. Elmer Willoughby on "Standardizing Electrical Measuring Instruments," was also taken up and discussed by Messrs. S. A. Rhodes, E. W. Ray, Professor Stine and others.

At the close of the discussion, Secretary Arnold called on Mr. Fred. A. Hamilton, member of the Institution of Electrical Engineers, of London, for some remarks. Mr. Hamilton has spent the last eighteen years as electrician-in-charge in laying Atlantic cables, and gave a very interesting description of the work, including the testing of faults, locating of breaks, etc. He also described the various instruments used in the work.

At the meeting of Council held on the same day the following Associate Members were elected: Cole, John E., San Francisco, Cal.; Davis, Harold McGill, Brooklyn, N. Y.; Dommergue, Franz J., Chicago, Ill.; Duncan, Thomas, Fort Wayne; Dunn, Kingsley G., San Francisco, Cal.; Etheridge, Chas. Locke, Chicago, Ill.; Eyre, M. K., New York; Ford, James S., Chicago, Ill.; Hadley, Arthur L., Fort Wayne, Ind.; Jones, Arthur W., Port Elizabeth, So. Africa; Keller, Chas. L., Chicago, Ill.; Larned, Sherwood J., Chicago, Ill.; Noxon, C. Per Lee, San Francisco, Cal.; O'Connell, J. J., Chicago, Ill.; Olivetti, Camillo, Ivrea, Italy; Rhodes, S. Arthur, Austin, Ill.; Roylance, L. St. D., San Francisco, Cal.; Sackett, Ward M., Chicago, Ill.; Sanderson, Edwin N., Newton Centre, Mass.; Slater, Frederick R., New York City; Strauss, Herman A., Newark, N. J.

BROOKLYN INSTITUTE OF ARTS AND SCIENCES.

On Monday, October 22, was given the second lecture in the course on "Electricity and Its Applications in the Arts and Sciences," in the Department of Electricity of the Brooklyn Institute. The lecture was by Prof. W. A. Anthony.

NEWARK, N. J., FEDERAL BUILDING.

The Supervising Architect of the Treasury Department has awarded to M. S. Dixey, Philadelphia, Penn., the contract for the plumbing, gas piping, and electric wire conduits in the United States public building at Newark, N. J., the amount of his bid being \$7,400; time allowed 120 working days.

REPORTS OF COMPANIES.

STREET RAILWAY EARNINGS.

BINGHAMTON RAILROAD COMPANY.

Comparative statements of the Gross Earnings and Operating Expenses of Road, for fiscal Years ending September 30, 1893 and 1894.

	1893.	1892.	1891.
Receipts.....	\$59,856.99	\$58,928.95	\$115,381.07
Operating Expenses.....	55,837.47	53,424.21	65,339.51
	29,999.52	40,504.75	49,091.56
Interest on Funded Debt.....	11,730.00	12,327.43	22,687.50
	18,269.52	24,177.82	23,514.06
Taxes.....	1,537.41	2,759.56	2,951.00
Surplus for Stock.....	\$10,502.11	\$25,417.76	\$23,363.06

During the year 1894 a portion of the system was operated by horse power.

COMPARATIVE QUARTERLY REPORTS:

(July, August and September.)

	1893.	1894.	Gain.
Receipts.....	\$34,568.37	\$41,909.16	\$7,340.79
Operating Expenses.....	15,696.93	18,043.04	2,346.11
	\$18,991.34	\$23,866.12	
Taxes.....	700.00	775.50	
Net Earnings (3 months).....	\$18,291.34	\$23,090.62	4,799.28
Operating percentage of Receipts, 46 per cent.		43 per cent.	

The following is from the report of the president of the Binghamton Railroad Company, Mr. G. T. Rogers, October 1, 1894. The company's lines are now nearly all operated by electric power.

President Rogers says:

The earnings shown above have been made during a period of construction and installation of electric equipment; also paving and sewer building; in consequence the service has been imperfect and irregular, and at times certain portions of the road were necessarily abandoned pending these improvements. The above statement is the more remarkable when considered with the fact that during the year one of the most important divisions has been operated with horse power,—this in connection with the marked increase in earnings shown each year as additional facilities have been afforded for transporting passengers from the residence portion of the city to the business centre, and to the parks, State Hospital, depots, and other important terminals, makes the following estimate of annual earnings and expenses, conservative for the entire system electrically equipped and well managed.

Gross earnings.....	\$130,000
Operating expenses and taxes.....	82,000
	\$ 48,000
Interest (when entire system is completed).....	\$ 27,000
Surplus for stock.....	\$ 21,000

DATA CONCERNING PLATINUM.

Messrs. Baker & Co., of Newark, N. J., have issued an exceedingly valuable pamphlet with the above title. While it is strictly a catalogue, profusely illustrated and devoted to the platinum utensils and wire manufactured by the firm, it contains a great deal of useful information besides. It will be sent free to anyone interested by applying to Messrs. Baker & Co., 408-414 N. J. Railroad avenue, Newark, N. J.

WESTERN NOTES.

THE ELECTRIC APPLIANCE COMPANY are at present distributing two little catalogues which will undoubtedly prove to be of very great interest to the electrical trade as they are the first separate catalogues published covering the goods which they list. The one is a complete catalogue of the Packard transformer illustrating and describing the process of manufacture and the detail of construction and giving data in regard to efficiency, regulation, etc. This is the first complete catalogue of the celebrated Packard transformer that has been issued.

The other catalogue covers the complete line of Packard lamps from the "Baby" to the "Mogul" with special appliances that have been designed by the Packard Company and manufactured solely by them for use in connection with their Mogul and other special lamps. This catalogue lists for the first time the Packard Theatre lamp a special lamp for foot, border and bunch lights; the Packard stereopticon lamp, (a substitute for calciums for theatrical work) and the focusing outfit for use in connection with same. In fact both of these catalogues are filled with information that will be entirely new to the majority of the trade. The Electric Appliance Company would be glad to receive applications from any who has not received copies of these interesting lists.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS
ISSUED OCTOBER 9, 1894.

Alarms and Signals:

Railway Annunciator, C. R. Alsop, Middletown, Conn., 527,098. Filed Nov. 2, 1893.

Comprises an electro magnetic indicator, an alarm circuit, and a separate mechanical releasing device.

Electric Track Signal, C. R. Alsop, Middletown, Conn., 527,099. Filed Nov. 27, 1893.

An automatic electric block signal system for steam railways.

Electric Signal, H. H. Wister, Colorado City, Col., 527,257. Filed Apr. 10, 1893.

Employs an insulated rim on the car wheel engaging an auxiliary rail along the track.

Signal Recording Device, W. H. Atkins, Rome, Ga., 527,258. Filed Dec. 22, 1893.

System of Electrical Block Signals for Railways, W. M. Outhbert, Brooklyn, N. Y., 527,267. Filed Feb. 16, 1893.

Conductors, Conduits and Insulators:—

Insulator, W. D. Trimble, Baltimore, Md., 527,254. Filed Feb. 2, 1894.

Insulator, E. J. Bullock, Wallingford, Conn., 527,317. Filed Nov. 27, 1893.

Contains an annular metal wearing surface held in a recess.

Insulator Pin, E. J. Bullock, Wallingford, Conn., 527,318. Filed Feb. 9, 1894.

Distribution:—

Electrical Converter, J. W. Packard, Warren, Ohio, 527,070. Filed Jan. 3, 1894.

Employs a cylinder enclosing both the primary and the secondary coil and consisting of alternate plates whose internal portion are of unequal width.

Dynamoes and Motors:—

Device for Protecting Separately Excited Generators, B. G. Lamme, Pittsburgh, Pa., 527,066. Filed Feb. 28, 1894.

Employs a normally closed break common to both armature and field magnet circuits and means for operating the break.

Running Compound Wound Dynamo Electric Machines in Multiple, W. B. Potter, Schenectady, N. Y., 527,075. Filed June 2, 1894.

The method consists in acquiring preliminary magnetization by energizing the series coil of the idle machine with current from the other machines.

Commutator Brush Holder, G. Bauch, Milwaukee, Wis., 527,137. Filed April 23, 1894.

Alternating Current Motor, C. Coerper, Cologne, Germany, 527,135. Filed May 15, 1894.

Employs an armature with unwound radial arms and two semicircular field magnets every two of whose adjacent poles act simultaneously on adjacent arms of the armature.

Adjuster for Field Magnets or Dynamo Electric Machines or Motors, M. Waddell, Bridgeport, Conn., 527,225. Filed Sept. 6, 1893.

Galvanic and Thermo-Electric Batteries:—

Electric Battery, M. E. Smith & M. F. Greer, Rochester, N. Y., 527,298. Filed March 23, 1894.

Employs a negative electrode and a porous cup in which is held the positive electrode and an exciting fluid containing chromic acid.

Lamps and Appurtenances:—

Electric Car Lamp, M. Mayer, New York, 527,211. Filed June 13, 1894.

Employs converging carbon holders and means for uniformly feeding one carbon and an electro-magnetic device acting upon the other carbon in drawing the arc.

Electric Arc Lamp, J. E. Woolverton, New York, 527,223. Filed Feb. 9, 1894.

Relates especially to the feeding mechanism and in means for moving one carbon in relation to the other in drawing the arc.

Electric Arc Lamp, J. E. Woolverton, New York, 527,229. Filed April 13, 1894.

Similar to 527,223.

Incandescent Lamp Socket, L. B. Peck, St. Johns, Mich., 527,335. Filed April 10, 1894.

Employs a dividing wall with terminals secured on either side.

Measurement:—

Workman's Time Recorder, E. G. Watkins, Gardner, Mass., 527,304. Filed July 22, 1893.

Miscellaneous:—

Electrical Amalgamating Apparatus, J. C. Ludwig, San Francisco, Cal., 527,150. Filed March 5, 1894.

Thermostat, L. G. Rowland, Camden, N. J., 527,375. Filed June 5, 1893.

Apparatus for Mounting and Operating Thermopiles, M. L. Severy, Boston, Mass., 527,577. Filed Feb. 16, 1894.

Apparatus for Utilizing Steam for Heating Thermopiles, M. L. Severy, Boston, Mass., 527,373. Filed Feb. 16, 1894.

Employs a steam boiler and a thermopile, one face of which is heated by the steam and the other cooled by the feed water.

Apparatus for Centering Electricity by Solar Heat, M. L. Severy, Boston, Mass., 527,579. Filed Feb. 16, 1894.

Employs means for constantly presenting the thermopile toward the sun from sun rise to sunset.

Railways and Appliances:—

Electric Locomotive, N. J. Raffard, Paris, France, 527,126. Filed July 23, 1891.

Employs a motor mounted on the axle and having multipolar field magnets presented endwise to the armature.

Electric Locomotion on Railways, J. J. Heilman, Paris, France, 527,344. Filed April 30, 1894.

Employs a dynamo driven by an engine and an exciting dynamo driven by a separate engine, together with a rheostat in the field magnet circuit of the main generator.

Conduit System for Electric Railways, W. A. Butler, New York, 527,235. Filed April 30, 1894.

A closed conduit with means for making contact between an outer and an inner conductor at intervals.

Track Switch for Electric Railways, A. F. Schinner, Milwaukee, Wis., 527,294. Filed June 16, 1894.

Provides mechanism by means of which the trolley makes contact with a separate strip of wire, throwing the switch point in one direction, while the next trolley contact will return it to its original position.

Conduit Electric Railway, J. E. Toole, Northumberland, Pa., 527,301. Filed Jan. 14, 1894.

Relates to the mechanical construction of a slotted conduit.

Trolley Wire Support or Hanger, S. C. Woodhead, Philadelphia, Pa., 527,335. Filed April 24, 1894.

Consists of a spindle with a hook at one end and a riveted head at the other and a wire support revolving around the spindle.

Switches and Out-Outs:—

Electrical Fuse Box, J. W. Packard, Warren, Ohio, 527,071. Filed Jan. 3, 1894.

Consists of two blocks one of which has projecting portions engaging a contact ring on the enclosing box.

Circuit Controller for Regulators, B. B. Ward, New York, 527,092. Filed Oct. 13, 1893.

Electric Switch, B. S. Kelsch, Chicago, Ill., 527,177. Filed May 23, 1894.

Employs loop line and main line conductors and a switch bar with ferules separated by insulation.

Telephones and Apparatus:—

Telephone Transmitter, T. McCoubay, New York, 527,114. Filed Aug. 16, 1894.

Employs powdered conducting material held in place by two discs with spirally corrugated surfaces.

Busy Test for Multiple Switchboards, R. H. Polk, Savannah, Ga., 527,333. Filed April 20, 1894.

Employs a condenser of such capacity that the talking current will not pass through it interposed in the wire connecting the source of current and the loop.

LARGE RUSHMORE PROJECTOR.

There are a large number of inland and coasting craft that depend almost entirely upon the search light for navigation at night, but in the larger lake and ocean steamers, the search light, while it would be of immense value, has been but little used, for the reason that lights used on the smaller vessels are much too small and the large naval lamps have been too expensive and difficult to keep in order. It was to meet the demand for very powerful commercial search lights that Mr. S. W. Rushmore has designed the lamp which is built at his shops in Jersey City. The lamp which has a special lens mirror of large focus, has a positive and independent feed and is wound for 175 or 200 amperes at the arc. While this lamp is fully as powerful as the best naval lights, its construction is almost as simple as in the smaller Rushmore lamps and all the parts are of large size and standard dimensions, so that repairs can be made without sending to the factory. The cylinder is perfectly balanced and one man can easily swing it in any direction.

These lamps are made to be run from the regular ship dynamo, or as in the larger sizes, from a special series wound dynamo coupled direct to engine.

Mr. Rushmore is furnishing a special motor dynamo for use where only the 250 or 500 volt current is available and this combination will be of great value to electric railways that desire to place a large search light as an attraction at some park or resort along the road.

The lamps are made in iron or brass with copper trimmings and a recent type has motors in the base to throw the light in any direction by means of switches located at a distance.

"THE LIGHT OF THE FUTURE."

Under this title a very interesting article appeared in *Cassier's Magazine* for July, from the pen of D. McFarlan Moore, E. E., accompanied by illustrations. Last week the Moore Electrical Company was incorporated under the laws of New York State. The Directors are Leopold Wallach, the prominent counsel for several Trunk Lines; Joseph Livingstone, the banker; Edward J. Wessels, general manager of the Genett Air-Brake Co., and Mr. Moore, the inventor. Neither Mr. Wessels nor Mr. Moore needs an introduction to our readers, as their work is well known. Mr. Moore's claims concerning current control and phosphorescent light have been made public at and since the time when he read his paper before the American Institute of Electrical Engineers on "A New Method of Current Control." For the past five years Mr. Moore was an engineer for the Edison, Thomson-Houston and General Electric Companies. On October first he tendered his resignation and is now devoting his entire energies to developing the business of the Moore Electrical Co., under agreement with them. The new company has secured all the patents owned jointly by Messrs. Wessels and Moore and an excellent laboratory has been placed at Mr. Moore's disposal. The productions of the new concern will be awaited with the utmost interest.

ANOTHER BIG POWER USER FOR NIAGARA.

THE *Buffalo Express* of Sept. 23 says:—E. G. Acheson, president, William H. Arison, secretary, and Charles G. McIlrain, attorney, of the Monongahela (Pa.) Carborundum Company, are in the city and are meeting with the officers of the Cataract Construction Company to sign the contract for 1,000 electric horsepower to be used by the former company in their new factory, which will be located near the Pittsburgh Reduction Company's plant on Buffalo Avenue. It is not known how soon the company will begin the erection of its plant here, but the time is very close at hand, as by the time they can place themselves in readiness, the Power Company will be ready to furnish them with the power.

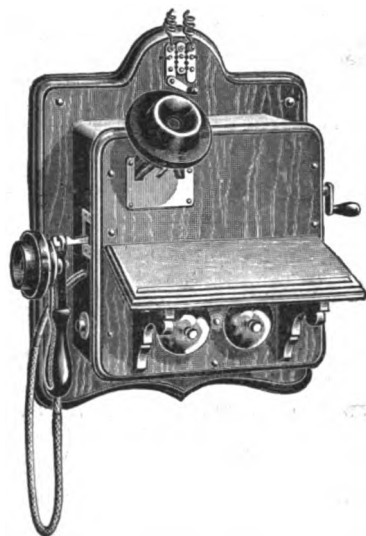
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE PHOENIX MAGNETO TELEPHONE.

THE accompanying engraving represents the new telephone set recently brought out by the Phoenix Telephone Co., Produce Exchange Annex, this city. This set has been gotten up with the view, not only of furnishing an apparatus of a practical, commercial type but also one which shall be free from existing patents.

The transmitter is of the magneto type, the magnet employed



THE PHOENIX MAGNETO TELEPHONE.

being of unusually large size and very powerful. The articulation is exceedingly clear and recent tests have shown it to work well through a 75 mile grounded circuit.

The magneto calling generator is able to operate through 18,000 ohms resistance so that the instrument can be directly attached to long lines.

The entire apparatus is exceedingly well made, and neatly gotten up.

The Phoenix Telephone Co. are exploiting their system for office, private line and exchange work, and are prepared to furnish all material, such as switchboards, poles, wires, etc.

HUBLEY MANUFACTURING CO.

The Hubley Manufacturing Co., of Lancaster, Pa., and 79 Chambers street, New York city, have issued a well printed and very complete catalogue of their electric railway material for all purposes. The little pamphlet is of convenient size, profusely illustrated, and presents its excellent contents in a concise and pleasing manner.

SIEMENS & HALSKE ELECTRIC COMPANY.

As our readers will remember, the Siemens & Halske Electric Co.'s factory was destroyed by the great lumber fire in Chicago, August 1. The company made a lease with the Grant Locomotive Works August 11; they commenced moving into the new works August 15; they finished and shipped the first generator, built entirely at the new factory, Oct. 15. Every available tool in the new works is now in operation and many of the tools which were destroyed in the fire have been duplicated so that from now on the company is in a position to finish one direct-coupled generator each day.

These few facts indicate the dauntless spirit of the company. They are to-day in a better condition for competition in the electrical field than before the fire.

WATERTOWN ENGINES FOR CORTLANDT AND HOMER TRACTION CO., N. Y.

The Cortlandt & Homer Traction Co. have just closed equipment for their entire steam plant. Specifications were drawn and contracts placed under the direction of Prof. R. C. Carpenter of Cornell University. The Company will put in four compound condensing Watertown engines with pumps, condensers, heaters, and four 100 H. P. boilers manufactured by the Watertown Steam Engine Co., of Watertown, N. Y.

GENERAL ELECTRIC CO. GETS GEDNEY CHANNEL CONTRACT.

The General Electric Co., New York, N. Y., have been awarded the Government contract for supplying the cable and necessary plant to replace the present system of electric light buoys in Gedney Channel, Lower New York Bay, in amount \$11,850.

LA ROCHE WON IT.

The La Roche Works, Philadelphia, Pa., have been awarded the contract for an electric lighting plant at the League Island Navy Yard, their bid being \$8,875. The bids were as follows:

Westinghouse Elect. & Mfg. Co.	\$11,818.
International Trading & Electric Co.	8,737.
Oreosent Elect. & Mfg. Co.	9,580.
G. S. W. Bubaker	15,990.
Stern & Silberman, alternating	8,575.
" " multiphase	10,575.
" " direct current	14,261.
McCoy-Howard Eng. Co.	9,850.
Pennsylvania Gen'l Elect. Co.	9,998.
La Roche Elect. Works	8,875.

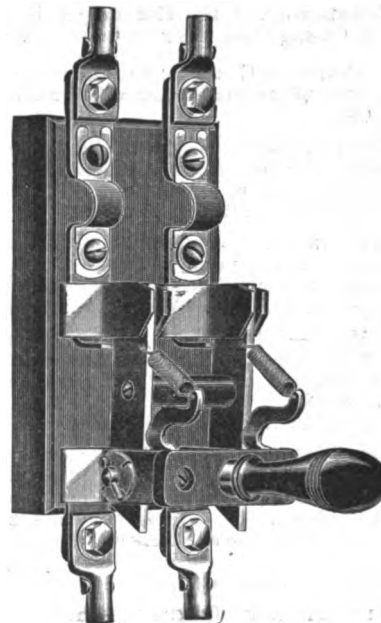
The call for tenders was noted in THE ELECTRICAL ENGINEER, Oct. 10, 1894.

BALL ENGINE ORDERS.

The Freeport Electric Railway, Freeport, Ill., has purchased a 150 H. P. engine from the Ball Engine Co., Erie, Pa. The Camden Horse Railway Co., Camden, N. J., have recently placed an order for two 850 H. P. vertical compound engines with the Ball Engine Co. J. W. Parker & Co., Philadelphia, representatives of the Ball Co., are installing one of their engines in the George W. Childs Public School Building, Philadelphia. The North Sub-District School of the Fourth Ward, Pittsburgh, Pa., is to have an electric light plant, the power for which is furnished by an engine built by the Ball Engine Co.

G. E. COPPER SNAP KNIFE SWITCH.

THE GENERAL ELECTRIC COMPANY announces a new line of station switches to meet the demand for a reliable switch which, sold at a low price, will nevertheless be as durable and effective in their work as the higher priced goods. It is known as the copper snap knife switch and differs from the generality of station switches in that the contacts and lugs, instead of being of cast



G. E. COPPER KNIFE SWITCH.

metal are of pure copper stampings, the contacts having ample contact surface to avoid heating and consequent loss. The hinges of the blades which move in the back contacts are so designed as to give excellent conductivity. The handle and cross bar are connected to the blades by strong spiral springs which pull the blade out, with a quick break action, only after the spring is under considerable tension. Thus the danger of arcing is reduced to a minimum. The switches are mounted on bases of hard white porcelain made by the General Electric Company at its own works at Schenectady, and are constructed in sizes from 75 amperes to 800 amperes double and triple pole with and without fuse holders.

HARRISBURG ENGINES.

The Harrisburg Foundry and Machine Works, of Harrisburg, Pa., have presented their friends with an artistic illustrated folder, from the press of Bartlett & Company showing their several types of engines, especially as adapted to direct connected generator work. The engravings are particularly well done, and the whole forms a very tasteful souvenir as well as a valuable catalogue.

ELECTRIC LIGHT AND POWER HOUSE EQUIPMENT.

Messrs. Edwin Harrington, Son & Co., of Philadelphia, issue a catalogue and price list of interest to electrical engineers and to operating light and power companies. It includes brief illustrated descriptions of their equipment machinery, such as hoists, traveling cranes, the Harrington transfer system, switches, turn tables, etc. There is also a list of some of the important companies using the Harrington system, including the Edison Illuminating companies of New York and Brooklyn, the Westinghouse Co. of Pittsburgh, the Fort Wayne Co., and others.

NEW YORK NOTES.

MR. C. WIRT, of Chicago has returned home after a professional trip East. Besides attending to his growing work as an electrical engineer, Mr. Wirt has found his time of late very much occupied with the specialties, such as dynamo brushes, lightning arresters, etc., that bear his name.

THE NEW YORK OFFICE of the Taunton Locomotive Manufacturing Co., manufacturers of the Wainwright feed water heaters and condensers, has been moved from 68 to 89-41 Cortlandt street.

THE AMERICAN ELECTRICAL MFG. CO., of St. Louis, makers of the American incandescent lamp, are opening an office in the Havemeyer Building, 26 Cortlandt street, New York. Mr. Ben Nahm, the President of the Company, will be in charge.

THE FIBERITE CO., of Mechanicville, N. Y., manufacturers of the Fiberite appliances, including railway material, had two exhibits in Atlanta, Ga., at the Convention of the American Street Railway Association; one at the Hotel Aragon, in charge of the Mason Electric Co., of Chicago, and the other in Convention Hall, in charge of the Hubley Mfg. Co., of Lancaster, Pa., and the Georgia Supply Co.

WESTERN NOTES.

MR. WM. HORNBERGER of the Hornberger Electric Co., Elkhart, Ind. was in Chicago last week on business for his company.

THE TAYLOR-BELDING ELECTRIC CO., Chicago, have reduced their capital stock to \$6,000 and changed the name to the Pioneer Electrical Mfg. Co.

MR. MAX BERG, Secretary of the Wallace Electric Co., Chicago, has returned from his trip to the Atlanta Convention, and reports having had a most enjoyable trip. The interests of his company were well looked after by Mr. Berg.

THE MANY FRIENDS and acquaintances of Mr. E. R. Stettinius, the genial secretary and general manager of the Stirling Boiler Co. will be pleased to learn that this gentleman was married at Richmond, Va. on the 18th inst. We extend our congratulations.

CROOKSTON, MINN.—It is said that the little place of Crookston now has one of the best telephone services in the West. The instruments used are the D'Unger "Self Cleaners," supplied by the D'Unger Long Distance Telephone Co., of Chicago, who are advertising and pushing actively for business.

THE WESTERN ELECTRIC CO. has just issued a very handsome and complete catalogue of electric railway supplies and detail apparatus. It is a quarto of 98 pages and embraces hundreds of articles, copiously illustrated and carefully indexed. The company is so well known for the excellence of its electrical goods in other lines, it will have no trouble in developing a large trade with its specialties in the railway field.

THE ELECTRIC APPLIANCE COMPANY, Chicago, report having secured the Western Agency for the electric railway supplies of the Lynn Manufacturing Company, and will carry a large stock in Chicago and be prepared to ship entire equipments from that point. A special catalogue and advertising matter is being prepared and will be ready for distribution very shortly. In the meantime the Electric Appliance Company will be pleased to hear from the electric railway trade with opportunities to quote them prices on material for electric railway equipments, and will promise to make attractive rates on the high grade Lynn material, which includes an insulation of which the manufacturers think very highly.

THE CHARLES E. GREGORY CO., Chicago, has found it necessary to again increase its staff of employees, having recently

secured the services of Mr. Frank J. Baker, formerly secretary of the Hammond Light & Power Co. Mr. F. A. Ellis, for several years lamp expert for the Standard Electric Co., Chicago, is also with the above company. The testing department is under the supervision of Mr. Oscar Michels, one of the most efficient men in his line, and who has been identified with Mr. Gregory's interests for the past eight years.

THE WILDER-SLOSS ELECTRIC COMPANY, Chicago, will soon have ready for the market a neat little device which will prove of great value to electric light consumers, as well as to central station men. It is called the "Meterette" and its object is to prevent the consumer from using more lights at any one time, than what he actually pays for. If, for example, he has his house wired for 50 incandescent lamps, but contracts to pay for an average of 20 lights, the meterette will automatically open the circuit as soon as more than 20 lights are turned on. As soon, however, as the number of lamps burning is reduced to the number contracted for, the instrument will restore the connection. The meterette will be made for any number of lights. It is very simple and will be sold at a moderate price. A device of this kind would seem to meet the objections urged against the installation of expensive meters and will no doubt increase the revenue of any central station compelled to make a flat rate to all or part of its customers. In a subsequent issue we hope to give a more detailed description of the device.

NEW ENGLAND NOTES.

MESSRS. G. M. ANGLIER & CO., New England Contractors of the Mather Electric Company, have removed their offices from 116 Bedford St., to 64 Federal St., Boston, Mass., where they have secured a suite of offices far more suitable for their business than at the old quarters.

THE CONSOLIDATED ELECTRICAL SUPPLY CO., of Boston, are enjoying a large business in the well known Lyons brake for electric, cable and horse railroads. They have recently shipped an order for 240 brakes for the Chicago Street Railway Co., where they appear to be giving the utmost satisfaction.

THE MATHER ELECTRIC COMPANY, of Manchester, Ct., report through their New York contractors, Messrs. H. B. Cohn & Co., 203 Broadway, the sale of all the electrical machinery for the new Odd Fellows Hall at Philadelphia, consisting of one 80 K. W., one 50 K. W., and one 80 K. W. direct connected generators and five Manchester type slow speed motors from 1 to 40 H. P.; also the sale to Henry R. Worthington Company for their Brooklyn Hydraulic Works, one 600 light dynamo, one 50 H. P. 220 volt generator and one 10 H. P. motor.

THE ATTLEBORO STEAM AND ELECTRIC CO., of Attleboro, Mass., whose station was burned last spring, started up their new plant Oct. 1st. The contract for re-building the entire electrical equipment was given to the Rushmore Dynamo Works, Jersey City. The station furnishes all the street and commercial lights in the city and surrounding towns and it is considered one of the finest plants in the State. The company did a large amount of special lighting for the bi-centennial celebration of the founding of Attleboro, Oct. 18 and 19. The success of the electrical display was completed by two Rushmore search lights.

THE THOMPSON-BROWN ELECTRIC CO., of Boston, will open on Thursday, October 25th, a handsome new store at 95 High street, and have issued a large number of invitations to their friends throughout New England, inviting their presence on that occasion, when a pleasant entertainment will be provided during the afternoon and evening. The Thompson-Brown Co. has been formed to do a general electrical supply business, and is composed of Mr. George Thompson, Jr., of New York, for many years associated with electric railway interests, and Mr. Maybin W. Brown, formerly president of the Brown Electric Co., of Boston. They will act as agents for The E. S. Greeley & Co., of New York, and will carry a full line of electric light and railway supplies, in addition to the usual lighter class of household goods. Associated with them will be Mr. H. B. Brown, brother of Mr. M. W. Brown, former travelling representative of the Brown Electric Co., and Mr. F. E. Pettingell, well known throughout New England and the States generally. Mr. Pettingell has not been directly associated with the electrical business for some years, but still has a host of warm friends in New England. Mr. Brown is thoroughly well known and needs no introduction, and will undoubtedly do his utmost to make his new company one of the leading electric supply houses in the East.

Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE Electrical Engineer.

Vol. XVIII.

OCTOBER 31, 1894.

No. 339.

ON ECONOMY IN CONDUCTORS AND THE LIMITATIONS IN THE APPLICABILITY OF KELVIN'S LAW.

BY

Wm. A. Anthony.

IN 1881 Lord Kelvin read before the British Association a most interesting and important paper upon the conditions leading to the greatest economy in the transmission of electric energy, and gave as the result of his investigation that the greatest economy is secured when the cost of the power wasted is equal to the cost of interest, depreciation, repairs, etc., on that part of the cost of the line that increases with the cross-section of the conductor. This was pretty generally understood to be a general law, but Prof. Ayrton pointed out some eight years ago, in a paper read before the Society of Telegraph Engineers that it is only in certain cases that the law holds good. That paper, however, does not seem to have been very widely read, and the idea seems still to prevail that Kelvin's law has a general application. For this reason, and not because I expect to add anything new to the subject, I venture to call attention to the matter.

In the electrical distribution of energy several cases may arise, depending upon the purpose for which the energy is to be used, the conditions that affect the generation, considerations of safety, etc., and each of these cases must be treated according to the conditions that determine it.

Suppose the energy is to be used for incandescent lighting at some distance from the generating station. The energy to be delivered at the receiving station is then given, the pressure at the receiving station and, therefore, the current, are also fixed.

Let w be the power in watts to be delivered, and v the pressure at the receiving station.

- " P be the power and
- " V the pressure at the generating station.
- " I = the current on the line.
- " r = the resistance of the line; and
- " l = the length of the circuit, that is, twice the distance the power is to be transmitted.
- " k = the cost of one watt-year delivered to the line; and
- " c = the cost per year for interest, repairs, etc., on a mile of conductor measuring one ohm in resistance,—this to include all the items of cost that increase in proportion to the cross-section of the conductor.

Leaving out of account all considerations relating to the variable use of the power, the problem to be solved is simple. We have a fixed quantity of power to deliver. We must, of course, provide for its generation. We must transmit this power to the receiving end, and we wish to do this at the least possible cost.

The cost for one year of the energy required for transmission is $k I^2 r$.

The cost for interest, etc., for one year is $c \frac{l}{r}$.

The total cost of transmitting the power w for one year is, therefore,

$$k I^2 r + c \frac{l}{r} \dots\dots\dots (a)$$

and we wish to make this the least possible.

Since I is fixed by the conditions of the problem, the only variable in the above expression is r , and it is required to so vary r that the cost represented by the expression shall be a minimum. Differentiating with respect to r , and equating the coefficient to zero we have:

$$k I^2 - c \frac{l}{r^2} = 0. \dots\dots\dots (1)$$

Multiplying both terms by r ,

$$k I^2 r = c \frac{l}{r} \dots\dots\dots (2)$$

which is Kelvin's law.

Solving (1) for r ,

$$r = \frac{l}{I} \sqrt{\frac{c}{k}} \dots\dots\dots (3)$$

and

$$\frac{r}{l} = \frac{1}{I} \sqrt{\frac{c}{k}} \dots\dots\dots (4)$$

But $\frac{r}{l}$ is the resistance per mile of the conductor and the equation shows that it is independent of the length of the conductor, or the distance of transmission. This was one of the surprises in Lord Kelvin's paper.

Now note the conditions under which this result was reached. An installation of incandescent lamps is to be supplied; w , v , and I are given quantities.

P , V , and r can be varied to meet the conditions imposed by considerations of economy.

Take another case. A fixed quantity of power is to be delivered to a distant motor, but considerations of safety, possibility of insulation, or some other consideration, limits the pressure upon the line. This limit will of course apply to the generating end of the line where the pressure is highest, hence V is a given quantity. V may also be fixed on account of taking the current from an existing system. Just as before, we have a given power to deliver and we wish to transmit it at the least possible cost. The cost of transmission is, as before,

$$k I^2 r + c \frac{l}{r} \dots\dots\dots (a)$$

The problem seems to be the same as the former. The only apparent difference is that I is unknown. The relation between I and the other quantities is given by the equation

$$w = V I - I^2 r \dots\dots\dots (5)$$

Let us assume that Kelvin's law applies to this case; then

$$k I^2 r = c \frac{l}{r} \dots\dots\dots (2)$$

We now have two equations from which I and r may be obtained.

Substituting the value of r from (2) in (5)

$$w = VI - I^2 l \sqrt{\frac{c}{k}} \dots\dots\dots (6)$$

$$I = \frac{w}{V - l \sqrt{\frac{c}{k}}} \dots\dots\dots (7)$$

Assume that 10 h. p. is to be delivered to a motor at a distance of 20 miles from a 500 volt circuit;

$V = 500$ volts; $w = 7,500$ watts; $l = 40$ miles.

Taking the cost of a horse power delivered to the line at \$50 per year, $k = \frac{1}{15}$ of one dollar. Take the cost of copper measuring one ohm per mile as \$100 per mile, then,

$$c = 10; \frac{c}{k} = 150; \sqrt{\frac{c}{k}} = 12\frac{1}{2} \text{ very nearly.}$$

Substituting these values in (7) we have:

$$I = \frac{7,500}{500 - (40 \times 12\frac{1}{2})} = \frac{7,500}{10} = 750.$$

$$\text{From (3) } r = \frac{40}{750} \times 12\frac{1}{2} = \frac{49}{75} = .65 +$$

$$\text{Volts lost on line, } 750 \times \frac{49}{75} = 490.0$$

Pressure at motor, $500 - 490 = 10$ volts

Power delivered, $750 \times 10 = 7,500$ watts

Power generated, $750 \times 500 = 375,000$ watts

Wasted in line, $375,000 - 7,500 = 367,500$ "

or 490 h. p. wasted to obtain 10 h. p., — not a very economical transmission!

If we substitute the value $r = \frac{49}{75}$ in (5) and solve for I we have

$$7,500 = 500 I - \frac{49}{75} I^2.$$

$$I = 750 \text{ or } \frac{750}{49}.$$

The last value satisfies eq. (5) but does not satisfy Kelvin's law eq. (2).

With this last value of I , we have:

$$\text{Volts lost on line} = \frac{49}{75} \times \frac{750}{49} = 10 \text{ volts.}$$

$$\text{Pressure at motor} = 490 \text{ volts.}$$

$$\text{Power delivered, } 490 \times \frac{750}{49} = 7,500 \text{ watts.}$$

$$\text{Power generated, } \frac{750}{49} \times 500 = \frac{375,000}{49} \text{ watts.}$$

$$\text{Wasted in line } \frac{750}{49} (500 - 490) = \frac{7,500}{49} \text{ watts.}$$

The required power is delivered with the same initial pressure, over the same line, by means of a current

$\frac{1}{49}$ as great as Kelvin's law calls for, and with a loss of

energy on the line $\frac{1}{(49)}$, as great as would satisfy Kelvin's

law. Kelvin's law, therefore, does not in this case give the most economical value of the current. Taking the value $I = 750$, the cost of transmission is

$$k I^2 r + c \frac{l^2}{r} = \frac{1}{15} (750)^2 \times \frac{49}{75} + 10 \times 40^2 \times \frac{75}{49} \\ = \$24,500 + \$24,500 = \$49,000 \text{ per year.}$$

Taking $I = \frac{750}{49}$, the cost is $500 + 24,500 = \$25,000$ per year.

It will be shown that neither of these solutions is the correct one. The fallacy lies in the fact that the solution for the minimum value of the expression for the cost of

$$\text{transmission } k I^2 r + c \frac{l^2}{r} \dots\dots\dots (a)$$

does not give Kelvin's law except when r is the only variable, while in the case under consideration I and r are both variable, dependent on each other by the relation given in equation (5).

Eliminating r from (a) by means of (5)

$$k (VI - w) + \frac{c l^2 I^2}{VI - w}$$

Solving for $I = \text{a minimum}$

$$I = \frac{w}{V} \left\{ 1 \pm \sqrt{\frac{\frac{c}{k} l^2}{V^2 - \frac{c}{k} l^2}} \right\} \dots\dots\dots (8)$$

Using same values as before

$$I = \frac{7,500}{500} \left(1 \pm \sqrt{\frac{150 \times 1,600}{250,000 - 240,000}} \right)$$

$$I = 88.5, r = 4.69.$$

Volts lost on line, 415.15.

Pressure at motor, 84.85.

Power delivered, $84.85 \times 88.5 = 7,500 +$

Power generated, 44,250.

Wasted on line, 36,750.

Cost per year for transmission,

$$\frac{1}{15} \times 36,750 + 10 \times (40)^2 \times \frac{1}{4.69} = 2,450 + 3,411 \\ = \$5,861.$$

Cost per year for transmission if conductors are computed by Kelvin's law, \$49,000.

These figures tell their own story.

Take another case. A water-power is available at a distance from a point where the energy can be utilized. The power available is fixed and it is desired to use it all to the best advantage. The pressure is limited by considerations of line insulation. Hence P and V , and, therefore, I are given. The problem now is, not to deliver a certain fixed quantity of energy at the least possible expense for transmission in the form of additional energy and interest and repairs on line, but to divide the energy available into two parts, one to be delivered and the other to effect the transmission, such that the returns from the part transmitted shall bear the largest possible ratio to the total cost of generation and transmission. The application of Kelvin's law to this case might, and often would, give a size of conductor such that the entire available energy would be consumed in it.

The available power is $P = VI$.

The power wasted is $I^2 r$.

The power that can be sold is $VI - I^2 r$.

If this is worth n dollars per watt per year its value is $n (VI - I^2 r)$.

The total cost of generating the power is $k VI$. The cost of interest and depreciation, etc., on the line is $c \frac{l^2}{r}$.

Hence the ratio of the revenue from power sold to the total cost of generation and transmission is

$$\frac{n (VI - I^2 r)}{k VI + c \frac{l^2}{r}} \dots\dots\dots (9)$$

It seems self evident that we shall be doing the best possible with our available energy, when the resistance and cost of the line are so adjusted that the above fraction becomes a maximum.

In this case the gain as compared with the results given by Kelvin's law is not very marked except when that law gives a conductor that wastes a large proportion of the

available energy. Since the cross-section of the conductor is in this case the only variable, Kelvin's law gives the minimum value for the sum of the waste energy and the interest, etc., on the line. But of what avail is it to reduce that sum to a minimum when by so doing all, or nearly all, the available energy is wasted? It is better to spend more for interest and depreciation, and have some power left to dispose of. By giving to r such a value that the value of the expression (9) becomes a maximum we obtain the largest possible proportion of revenue to expenditure.

Other cases might arise, each requiring its own solution. We might, for instance, have a given amount of power at the generator to be delivered at a given pressure at the receiver. The pressure at the generator and the size of the conductor might be the given quantities. There are in all eleven different cases, most of which may be solved for a condition of maximum economy, but in only one is the condition of maximum economy satisfied by the conditions given by Kelvin's law. The condition of maximum economy of course does not always lead to a practical solution. The conductors given might in some cases run too hot; the power that could be delivered might, at best, cost more than could be obtained for it; but these are considerations that must be dealt with separately. As already intimated, it seems to me a self evident proposition that the maximum economy is reached in any case when the revenue from the energy delivered bears the largest possible ratio to the total expense of generation and transmission. When the energy to be delivered is given, the condition of maximum economy is that the cost of transmission shall be a minimum. The cost of transmission is made up of two items, viz., (a) the cost of the energy required to effect the transfer and (b) the cost for interest and depreciation on the line. (a) is proportional to $I^2 r$ and (b) is proportional to $d + \frac{l}{r}$

where d is that portion of the expense on the line that does not vary with the size of the conductor. Now suppose I to be given by the conditions of the problem; then the item (a) varies as r , and the variable portion of (b) varies as the reciprocal of r . In other words the product of these two items is constant. It is well known that in such a case the sum of the two quantities is a minimum when the quantities themselves are equal, which leads us at once to Kelvin's law.

But suppose I is not given by the conditions of the problem, but is a variable as well as r ; then the sum of the two items depending respectively on $I^2 r$ and $\frac{l}{r}$ is no longer a minimum when they are equal, but, as I have shown, making them equal may give a sum many times the minimum value.

When the quantity of energy that can be generated is given, the condition of highest economy no longer requires that the cost of transmission shall be a minimum, since making it a minimum might in some cases demand the entire available energy to effect the transmission.

Let me say here that I do not know how we have fallen into the habit of calling the energy consumed in transmission "waste energy." It is an entirely legitimate part of the expense of transmitting energy from the generator to the receiver and is no more waste than interest and depreciation on the line are waste. If the line is poorly insulated and leakage occurs along it, the energy so lost might be properly termed waste. In transporting coal from the mines to the consumers no one thinks of calling that part of the coal that is used on the locomotives "waste" coal. Why should we call that part of the electric energy that is used for transmission "waste"?

My object in this article has not been to give an exhaustive treatment of the subject, but merely to point out the general principles upon which solutions are to be based and to indicate that the different cases that arise lead to totally different results.

ELECTRICAL MACHINIST PRACTICE.—VII.

BY

James F. Hobart,

THE mechanical part of coil winding is of great importance, and is strictly within the field of the "Electrical Machinist." To the electrician belongs the task of determining the size and length of the wire used, and to the machinist belongs the work of putting the wire in place. If he is able to design tools and appliances for putting the wire in place quicker and better, then that man is worth more to his employer, and should receive higher wages, than the man who plods along in the old way.

The matter of continuously testing the wire that is being wound into coils, as discussed in the last paper, is important. In transformer winding, it would prove valuable, and save a good many transformers from being rewound. It is the custom, in some transformer factory testing rooms, to deal in a very arbitrary manner with apparatus that shows leakage. More than once, I have seen the inspectors get out of patience with a transformer so badly short circuited or cross connected that it would not test up as high as desired. The almost inevitable

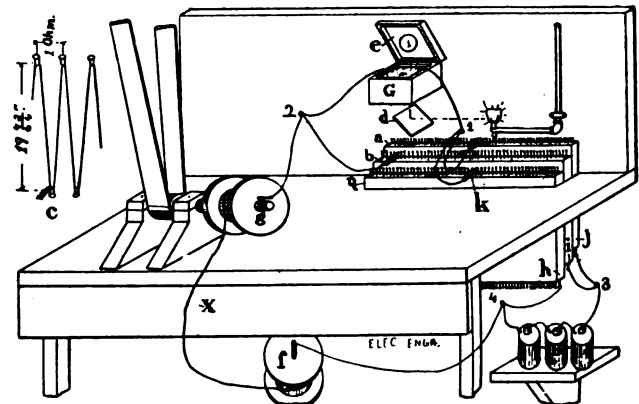


FIG. 27.

result would be the sending of such a heavy current through the transformer that it was burned out at once. Then it was sent back to be re-wound.

Continuous testing would have saved all this time and material, and the output of the factory increased accordingly. The Wheatstone bridge offers a ready means of testing, but a special apparatus designed by the writer, and which costs not one-tenth as much as a bridge, does equally good work, and is easier to handle for that particular purpose.

Fig. 27 will give a general idea of the apparatus, and the succeeding engravings present some of the details. About all that was needed to be purchased, was a coil of fine iron wire; the galvanometer was made in the shop. In order to comprehensively describe the device, we will construct one, and as the work progresses, the use of each part becomes manifest.

Suppose that 1,000 coils, each of 150 ohms resistance are to be wound up, and we must be particularly careful regarding the insulation of the coils. Assume that No. 30 (B. W. G.) wire is to be used (.012 inch diameter) and that it comes in 5 lb. spools, each having a resistance of about 82½ ohms. Sometimes it will be necessary to splice on a new bobbin of wire in order to finish a coil, but, by a little calculating, partly used bobbins may be kept for this purpose, making it unnecessary to ever measure over 82½ ohms, or less than 150.

A set of resistances to measure the above quantities direct, may be easily constructed, but as arranged in Fig. 27, only a total resistance of 300 ohms is necessary, 100 ohms each in the multiplier, the divisor and the variable resistance giving a range from .01 to 10,000 ohms. By using No. 30 iron wire for the resistance only about one-third pound will be necessary. As copper wire of that gauge has a resistance of 164.462 ohms per pound and iron has about 6 times as much (6.19) resistance as copper, thus giving 986.77 ohms per pound of No. 30 B. W. G. (.012") iron wire. If something a little stouter is fancied, use No. 28 (.014") of which about three-fifth pound will answer the purpose.

However, as the smaller wire (No. 30) requires less room, that size will be adopted, and is used in Fig. 27. It requires about 2 feet 3.8 inches of this wire to make one ohm resistance, and when the wire is strung upon nails, as in Fig. 27, the rows must be 1 foot 1.9 inches apart so that each loop may have a resistance of one ohm. This is more clearly shown at *c*, in the illustration, where the nails are driven far enough apart to require 13.9 inches of wire to reach from one nail to a corresponding point on the opposite nail. Some wire is taken up by passing over the edges of the board, so that one about 13 inches wide will be found about right.

Putting the nails one-quarter of an inch apart, shows that boards a little over 25 inches long will be necessary. But the method of connection shown in Fig. 28, shows that 102 nails will be needed, one extra at either end of the coil. This engraving also shows the method of attaching the connecting cord, which takes the place of the plugs used in ordinary instruments, and shown in detail by Fig. 29, and in place in Fig. 27, at *K* and on *b* and *a*. The clip, Fig. 29, is made of sheet brass, the end swaged down and bent as shown; the soldering on of the connecting wire, which is better if made of flexible cord, completes the clip.

In plugging in resistance, with this instrument, the clip is placed between two of the brass wire nails shown at top and bottom of board in Fig. 28. If 5 ohms are required to be cut in, the clip will be inserted between nails 5 and 6. It makes no difference if nail 6 and its resistance wire is in connection, for it does not enter into the equation as a factor, the total resistance is between *a* and 5, = 5 ohms.

Returning to Fig 27, the apparatus may be described as

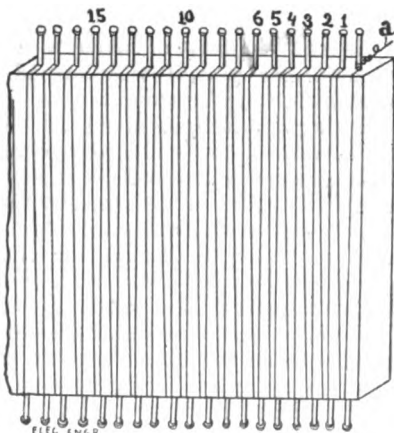


FIG. 28.

follows: Three resistance boards, *a*, *b* and *R* are made up of 100 ohms each. There are 102 nails on the top, and the same number on the bottom edge of each board. The electrical connections shown, will be discussed later. A plain galvanometer *G*, is located as shown, somewhere above, and at the back of the bench. In order that the mechanic may be able at all times to see the galvanometer, and that, too, without getting off his stool and bending over the instrument, a piece of mirror plate *e* is put into

the cover of the box, and adjusted at such an angle that he can see the reflection of the galvanometer needle. To give light, the bottom of the galvanometer box is removed, or a hole made through it, and the galvanometer illuminated by a beam of light from the gas jet, the mirror *d* throwing the beam of light into the box. A 4 candle power electric lamp may be put into the bottom of the box if current is at hand.

The battery *B* is placed on a shelf underneath the bench,

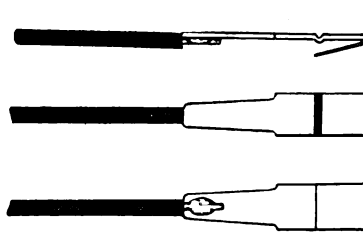


FIG. 29.

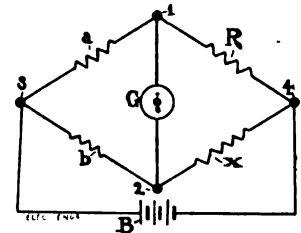


FIG. 30.

and connected, as shown, to the *a* and *b* resistance boards. The other terminal of the battery goes to the variable resistance *R*, and to the bobbin of wire *f*, which, together with coil *g*, forms the resistance *x*, which is to be measured, and any decrease therein is promptly noted. Following up the connections, the other end of *x*, at 2, goes to the galvanometer and also to the "multiplier" resistance *b*. The other terminal of the galvanometer is connected to the plugging clip on "divisor" resistance *a*; also to clip *k* on variable resistance *R*.

For convenience in connecting the various terminals, they have been lettered and numbered alike in both Fig. 27 and Fig. 30, the latter corresponding to the regular Wheatstone bridge connections, except the two keys which are dispensed with. In making connections, it is always well to put in clip *b*, first, then *a*, and lastly *R*, or *k*. The object is the same as in closing the keys of a Wheatstone bridge, namely, to close the battery key first, thus allowing the first rush of current to subside by the time the galvanometer key is closed.

The resistances *a* and *b*, also the battery *B*, may be arranged according to the old rule, if desired, viz.:—*b*, should be intermediate between $r + a$ and $\frac{Ga}{G + a}$; and

R should be intermediate between $G + a$, and $\frac{ra}{r + a}$, *r*

being the resistance of the battery. But as we only desire to note a variation of resistance in *x*, the above is not absolutely necessary; neither is it necessary that the boards *a*, *b* and *R*, should be calibrated to exactly 100 ohms of 100 divisions each. It is not necessary that the coils on the resistance board be graduated to any known standard. All that is required, is that they give a balance on the galvanometer. If, however, the three resistances be calibrated, they can be used in close measuring, as from their peculiar construction, they are non-inductive. German silver wire may be used, and temperature variations will be reduced.

BROOKLYN BRIDGE CARS LIGHTED BY ELECTRICITY.

After some four months' deliberation, the trustees of the New York and Brooklyn bridge have decided to light all of the cars with incandescent electric lamps. The contract has been awarded to the Electrical and Mechanical Engineering and Trading Co., No. 39 Cortland street, N. Y.

The plant will consist of two high speed automatic cut-off engines, each engine driving a multipolar direct driven generator. The generating plant will be located in the power station at the Brooklyn end of the bridge. Each car will be fitted with ten incandescent lamps of 16 candle power each.

The specifications drawn by Chief Engineer Martin, under which the contract has been awarded, were exceedingly rigid in every detail, requiring the best method of construction that is known at this stage of the art.

CARBORUNDUM ELECTRIC LIGHT CARBONS.

Many efforts have been made to improve the quality of illuminating carbons, for the purpose of lengthening the life of the filaments, rods or points, and also to produce a combination of carbon with other substances that would give more light for the electrical energy consumed. Many combinations of materials have been made, both in the mass of the filament, rod or point, and in the coating of the mass. The main object of inventors has always been to produce a carbon containing a material having an excessively high fusing point and equally difficult of oxidation, and at the same time having a high luminescent value.

Mr. E. G. Acheson, well-known as the inventor of carborundum, has recently produced a carbon in which he claims to have covered these points. He takes pure carbon and carbide of silicon (carborundum), reduces both to fine powder and mixes them in the proportions of nine parts of the former to one of the latter, together with tar or any other good binding material. The mixture is then baked and molded into the proper form for use.

In order to get the full and complete effect of the illuminating qualities of the carbide of silicon more distinctly separated from that of the carbon, the ordinary cored carbon rod or point is used and the core is filled with the carbide of silicon, either alone or with a binding agent.

For the filaments of incandescent lamps the carbide of silicon in a very fine powder is mixed with and suspended in the oil used in the oil bath, for the treatment and building up of the carbons, and in the process of depositing the carbon from the oil bath onto the filament, the fine particles of carbide of silicon, become fixed to the filament simultaneously with the deposit of carbon.

As carborundum is formed at a temperature approximately that of the electric arc, it is necessarily free from all volatile matters and eminently fitted (as the result of having already existed at these high temperatures) for the light-giving body. It has also been demonstrated that it resists oxidation to a greater extent than any other known material, having resisted such chemical action when highly heated and exposed to a stream of oxygen gas. Associated with these two essential qualifications of infusibility and non-oxidizability, is a third equally valuable one, that of luminescence, as it is claimed to produce a greater amount of light for the electrical energy consumed than any illuminating body heretofore used.

MAGNETIC LEAKAGE IN DYNAMO-ELECTRIC MACHINERY.—VIII.

BY

Alfred E. Wiener.

d. Ampere Turns for Compensating Armature-Reactions.

The armature winding exerts a double influence upon the magnetic circuit: (1) a direct weakening influence upon the magnetic field, due to the lines of force set up by the armature-winding, and (2) an indirect, secondary influence by shifting the magnetic field in the direction of the rotation, thereby causing greater magnetic density to take place in those portions of the polepieces at which the armature leaves the poles than in those at which it enters.

The direct effect of the ampere turns upon the field has been studied experimentally by Prof. Harris J. Ryan', who in his paper presented to the Am. Inst. of El. Eng.,

on Sept. 22, '91, has shown that the armature ampere-turns acting directly against the field ampere-turns can be expressed by:

$$at'_d = \frac{K' \times C}{p'} \times \frac{\alpha}{180}, \dots\dots\dots (60)$$

where at'_d = counter m. m. f. of armature per magnetic circuit, in ampere-turns, to be compensated for by additional winding on field frame;

K' = Total Number of Turns on armature;

$K' = K$, for ring armatures;

$K' = \frac{1}{2} K$, for drum wound armatures; (K = Total Number of Armature Conductors.)

C = Total Current Output of dynamo, in amps.;

p' = Number of armature circuits electrically connected in parallel;

$\frac{K' \times C}{p'}$ = Total number of ampere turns on armature;

α = Angle of lead, approximately equal to half angle between pole-corners.

As to the second, indirect, influence of the armature field, the density in the Sections I, I, Fig. 54, of the pole-

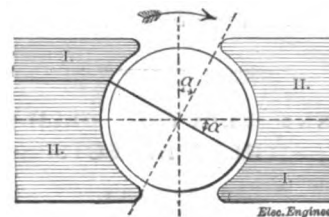


FIG. 54.

pieces, on account of the distortion of the field caused by the action of the armature-current, is greater; in the Sections II, II, however, smaller than the average density obtained by dividing the total flux by the sectional area of the polepieces.

If the average density in the polepieces, $\Phi' + A_p$, is denoted by $\mathcal{B}_p$, then the distorted densities are

$$\left. \begin{array}{l} \text{in sections I, I: } \mathcal{B}_p' = \mathcal{B}_p \times \frac{1}{1 + \sin \alpha} \\ \text{in sections II, II: } \mathcal{B}_p'' = \mathcal{B}_p \times \frac{1}{1 - \sin \alpha} \end{array} \right\} \dots\dots\dots (61)$$

The m. m. f. required to produce these densities in the polepieces can be found from

$$at_p = l_p \times \frac{f(\mathcal{B}_p') + f(\mathcal{B}_p'')}{2}, \dots\dots\dots (62)$$

where l_p = length of magnetic circuit in the polepieces, in inches;

$f(\mathcal{B}_p')$ and $f(\mathcal{B}_p'')$ = specific magnetomotive force per inch length for the densities $\mathcal{B}_p'$ and $\mathcal{B}_p''$, respectively, formula (61), for the material used; to be taken from Table IV, or from Fig. 51.

But since the m. m. f. necessary to produce the original average density, is

$$at_p = l_p \times f(\mathcal{B}_p), \dots\dots\dots (63)$$

which is smaller than at_p' , we can find the number of ampere turns by which the field magnetomotive force is diminished on account of this indirect effect of the armature-current, by subtracting (63) from (62). Doing this we obtain:

$$at_p'' = at_p' - at_p = l_p \times \left\{ \frac{f(\mathcal{B}_p') + f(\mathcal{B}_p'')}{2} - f(\mathcal{B}_p) \right\} \quad (64)$$

The total weakening effect of the armature winding per

1. Harris J. Ryan, Trans. A. I. E. E., vol. viii., p. 451 (Sep. 22, 1891); THE ELECTRICAL ENGINEER, xli., p. 377, 401 (Sep. 30 and Oct. 7, 1891); Electr. World, xvii., p. 299 (Oct. 3, 1891).

magnetic circuit can therefore be found by combining (60) and (64), thus:

$$at_r = at_r' + at_r'' \\ = \frac{K' \times C}{p'} \times \frac{\alpha}{180^\circ} + l_r \times \left\{ \frac{f(\mathcal{B}_r') + f(\mathcal{B}_r'')}{2} - f(\mathcal{B}_r) \right\} \quad (65)$$

This is the total number of ampere turns by the amount of which the exciting power of each magnetic circuit is to be increased in order to compensate for the reactions of the armature-current upon the field.

Making the above calculation of at_r by formula (65) for a great number of practical machines, the writer has found that with sufficient accuracy the complex formula (65) can be replaced by the simple equation

$$at_r = \frac{K' \times C}{p'} \times \frac{\alpha}{90^\circ}, \dots\dots\dots (66)$$

in case of *cast-iron* polepieces, and by

$$at_r = \frac{K' \times C}{p'} \times \frac{\alpha}{120^\circ}, \dots\dots\dots (67)$$

in case of *wrought iron* and *steel* polepieces, the latter materials requiring less magnetomotive force per unit length, for even considerably higher magnetizations (see Table IV) and therefore having a less marked indirect armature reaction than the former.

ON PERSISTENT ELECTRIC OSCILLATIONS AND THEIR EFFECTS.¹

BY H. EBERT.

IN recent times investigators have applied themselves with ever increasing interest to the problem of producing light by electric oscillations or alternate currents of high frequency, such as are obtained by condenser discharges. Only in a few isolated cases, however, have the arrangements fulfilled the necessary conditions for obtaining the maximum lighting effect from the given supply of energy. Furthermore, as far as known to the author, there have been no measurements made of the economy of lighting effected in this way. However brilliant the luminous effects obtained by Tesla may have been, it is only by measurements of the total energy expended to produce the lighting effect that we can hope to arrive at a conclusion as to whether an economical advance in the art of lighting is to be expected from this system. The author wishes to show that by observing the necessary conditions, considerable light effects can be obtained by very simple means from very long continued electrical movements of the kind just mentioned.

The conditions necessary for obtaining the maximum luminous effects by the influence of electric oscillations on rarefied gases, have been investigated by E. Wiedemann and the author by means of Lecher's parallel wire arrangement. In all cases the result was obtained, that the best effects could only be attained when the secondary circuit was exactly "tuned" to the primary discharging circuit. The oscillations in the secondary circuit must in fact be what is called, in the theory of sound, resonant. It was found also that perfectly regular oscillations could be obtained only when air condensers were employed. When the Leyden jar, or any other condenser with solid dielectric was used, disturbances and irregularities were introduced by the well known residual actions that occur in these cases.

These, and similar experiments, showed that to obtain luminous effects in a rational manner by means of electric oscillations or high frequency currents, we must—

First.—Time the primary and secondary circuits exactly to one another. That is to say, the time of oscillation $T = 2\pi \sqrt{L/C}$ must be the same, or in a simple harmonic relation for both circuits.

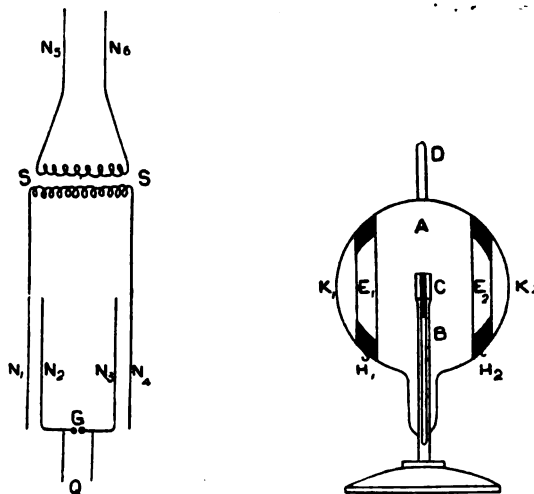
Second.—The capacity of the air or oil condensers in the circuits must be as small as possible, in order to reduce the damping to a minimum. The logarithmic decrement of the electric oscillations is given by the expression $\pi R \sqrt{C/L}$ (R , the ohmic resistance; C , the capacity; and L , the self-induction of the circuit). It appears from this expression that, as stated, C must be as small as possible, and L as large as possible for a given R ; but the limit of increase of L is soon reached.

It is not necessary to use high tensions, since it has been found that intense light effects can be produced by the movement

of exceedingly small quantities of electricity, provided only that the oscillations follow each other regularly and are persistent.

Keeping these considerations in view, a simple apparatus has been designed which has proved very effective for producing electric light by high frequency currents. The principle of the apparatus can be readily seen from the diagram (Fig. 1). The current (from an influence machine, an induction coil, or a sufficiently highly transformed alternating current) coming in by the conductors, Q , charges the two condenser plates, N_1 and N_2 , which, thereupon, induce upon the plates, N_3 and N_4 , corresponding charges. When a spark passes at G , the charges heaped up on N_1 and N_2 equalize themselves, with oscillations, through the coil S . Round this coil, S , is wound a similar coil connected to the plates, N_5 and N_6 , of the secondary condenser. Between these two plates is developed the high frequency field. Vacuum tubes or other objects to be acted upon may be introduced between the plates, N_5 and N_6 , or they may be metallically connected to them by wires. There is thus no direct metallic connection between the primary and secondary circuits, but they mutually act upon one another by the lateral induction of the spirals. By changing the distance between the condenser plates, the two circuits can be tuned into exact unison with one another. By changing the capacity, by applying longer or shorter spirals, S , or by increasing or diminishing the length of the primary spark gap, or the number of the sparks, the conditions of the experiment can be indefinitely varied, and more especially the frequency of the oscillations can be varied within wide limits.

The condensers are simply made of couples of metal plates mounted so as to slide on glass rods passing through their centres. There is no danger of leakage along the glass rod, as the spark gap is only 2 to 3 mm. in length. It is found to be much better



FIGS. 1 AND 2.

to use many small sparks, provided they are regular and sharp, than long sparks.

With this apparatus, 20,000 oscillations will take place before the amplitude is damped down to the 2.7th part of the original value. If the number of sparks at G is sufficiently increased (and this can be done without a large supply of electricity on account of their shortness) the field between N_5 and N_6 may be kept in an almost uninterrupted state of oscillation.

Since everything in the wave apparatus is so adjusted that the activity of the oscillations is a maximum, only a very small exciter is necessary. Even a single plate influence machine serves to excite it, though, of course, the phenomena with a multiple plate machine are much more brilliant. A medium sized induction coil gives very fair luminous effects, but generally it is not so suitable as the influence machine, because the supply of electricity is not usually sufficiently regular.

The application of this resonant wave apparatus to the excitation of vacuum tubes, and spectroscopic investigations at low temperatures is described, but we give here only its application to the production of light. Wiedemann and the author had shown in previous investigations that regular, weakly damped, electrical oscillations possessed a very remarkable power of exciting cathode rays of great intensity, which have a remarkably great capacity of producing fluorescence or phosphorescence, or to speak generally, luminescence, with very small expenditure of energy.

Even with very small sparks and amounts of energy on the secondary condenser, these cathode effects attain, when everything is properly tuned, an intensity which is quite comparable with that obtained by using large alternating generators. If a suitable phosphorescent substance is exposed to these rays, it will emit a considerable amount of light. Even when powerful alternating currents are employed to excite the phosphorescence, scarcely any heat is produced. A lamp is thus obtained which

¹ Wied. Ann., Vol. LIII., p. 144.

emits almost only visible rays, without development of heat, and consequently the amount of energy which the lamp consumes is enormously small.

A simple, but very economical "luminescent lamp" may be constructed by fusing the glass tube, B, Fig 2, in the glass bulb, A, closing it at the lower end, and fixing a disc, C, of compressed luminous paint (Leuchtfarbe) by a wire at the top. The bulb is then exhausted by the tube, D, and closed. Two strips of tinfoil, E_1 and E_2 , are glued on, and furnished with hooks, H_1 , H_2 , to which the condenser plates, N_1 , N_2 , of the wave apparatus are connected. When the electric oscillations act upon the coatings, E_1 , E_2 , active cathode rays are formed on the inner surface and perpendicular to it. These rays, though almost invisible themselves, produce a strong luminescent light upon the surface of the luminous paint on which they converge, and the light radiates out through the transparent ends, K_1 , K_2 , of the bulb.

A series of preliminary experiments were made to determine the efficiency of the "luminescent lamp." The candle-power was found to be about one-thirtieth to one-fortieth of the amyl acetate standard, which is approximately equal to the English Board of Trade standard candle. The energy expended, being difficult to measure directly, was calculated from the capacity and potential of the secondary circuit. It was found that the energy actually expended in producing the light was about one-millionth part of a watt. By comparing the brightness of this lamp in the visible part with that of the amyl acetate lamp, and calculating for both the total energy consumed in their maintenance, it was found that the high frequency lamp consumed from 1,500 to 2,000 times less energy than the amyl acetate standard.

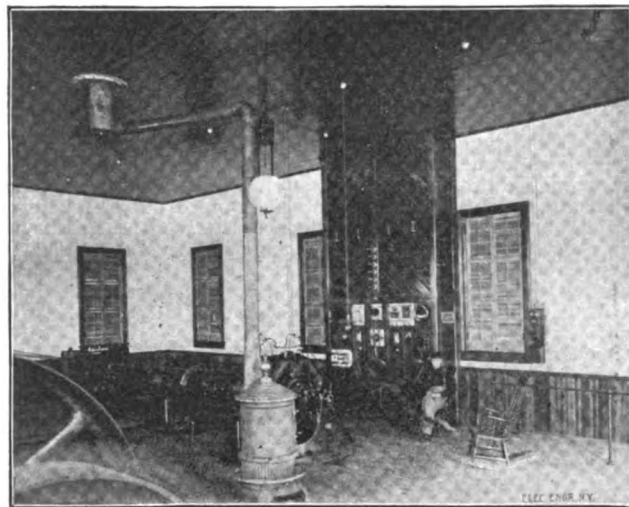
One difficulty in the way of the practical application of the high frequency lamp is that the high frequency currents could not be carried to great distance even in a straight cable, on account of the resistance which self-induction would oppose to such rapid oscillations; but the difficulty may to a certain extent be overcome by effecting the transformation to high frequency at the lamps. Since only condensers of small capacity, and small inductances are required, a simple and very compendious apparatus of the kind described could be combined with the lamp.

The economy of all arrangements which were not perfectly tuned as above explained was found to be much less.

THE BUCHANAN, MICH., ELECTRIC LIGHT PLANT.

In a recent number of THE ELECTRICAL ENGINEER, Mr. Franklin L. Pope gave a very interesting description of a small electric light plant, with data covering the power, power house, apparatus, distribution and other notes of interest. The article ends with a demonstration of the feasibility of making a plant of that size pay a fair dividend on the necessary investment. The plant is of the alternating current system and generates current for incandescent lighting only. A smaller plant operating in a still smaller town and furnishing in addition to the incandescent lights not only arc lights but power for electric motor service,

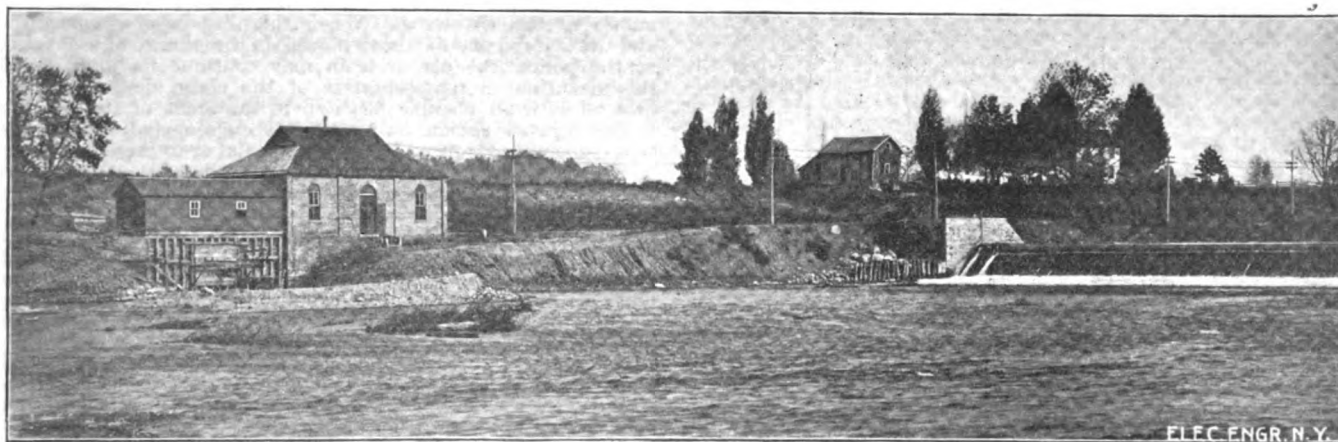
vice-president of the company, Mr. Peter English, a gentleman of wide experience in the gas, water works and electric light field, was induced to come to Buchanan, where he secured the franchise already held by the city, for building a dam across the St. Joseph River. Mr. English built the dam, issued bonds and built a system of water works. He then secured a franchise from the city for an electric light and power plant, which carried with it a ten years city contract for 86 arc lights. After this the Buchanan Power and Light Company was incorporated with the result that a suitable station was built and the necessary appar-



DYNAMO ROOM, BUCHANAN ELECTRIC LIGHT STATION.

atus installed. The electrical equipment was all furnished by the Standard Electric Company, Chicago, and consists at present of one 45 kw. 500 volt power generator; one 65 kw. 1000 volt generator, and one 60 light 10 ampere arc dynamo, with of course a full line of necessary adjuncts, such as converters, switchboard, etc. A substantial pole line carries the three circuits to town, a distance of a little over $1\frac{1}{2}$ miles, American Electric Company's wire being used throughout.

The water wheels consist of three "New American" turbines of 150 H. P. each, furnished by the Dayton Globe Iron Works. The turbine shafts are geared direct by means of bevel gears to the main shaft, which is driven at a normal speed of 250 revs. This shaft is put up in the most substantial manner, is 6 inches in diameter and 75 feet in length. All the pulleys are mounted



STATION AND DAM, BUCHANAN, MICH., ELECTRIC LIGHT PLANT.

is shown, from data recently come under our observation, to be equally remunerative. This particular plant is located in the city of Buchanan, Mich., a picturesque little town located near the St. Joseph River, and having scarcely 2,500 inhabitants.

Ever since electricity first began to drive from the field its would-be rivals, gas and oil, the question of an electric light plant has been agitated at Buchanan, but until about a year ago, no one could be found with sufficient faith in the city's future to invest a sufficient amount of capital in an undertaking of this kind. Through the persistent efforts of Mr. John Holmes, now

on quills and are provided with friction clutches so that any pulley may be started or stopped at pleasure.

The dam has a height of 10 feet, giving from 11 to 12 feet of water in the wheel pits. The entire power available has been calculated at not less than 8,000 H. P. and by building a second dam further down the river this will ultimately be doubled, the intention being to eventually transmit power to neighboring towns within a radius of 20 or 25 miles.

The output of the station at present consists of 700 incandescent 16 c. p. lamps, 45 2,000 c. p. arc lamps and 55 H. P. in motors.

The patronage is, however, increasing constantly, some 100 H. P. additional in motors being in prospect and over 500 incandescents having yet to be wired up. Of the arc lamps the city pays for 36 at the rate of \$500 each per year, the same price being charged for commercial arc lights, 12 o'clock schedule. For 16 C. P. commercial lights the rate is \$6 per year. For domestic lighting the charge is \$18 for the first three lamps, and \$1 per year for each additional lamp. For each incandescent lamp a charge of \$2 is made for wiring, a similar charge of \$5 each being made for arc lamps. Lamp renewals are paid for by the consumers.

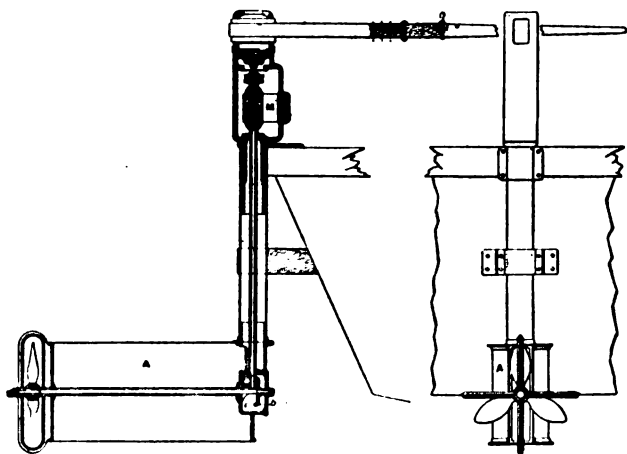
For power service the charge is \$20 per H. P. per year for 50 H. P. and over, and \$25 per H. P. per year for less. Water power can be rented if desired at \$10 per year per H. P. The plant runs night and day and although having been in operation only since last August, is already on a paying basis, clearing 10 per cent. on the investment. This is no doubt due to the small expense account, the entire plant, for instance, being operated by three men, viz., a night man, a day man and a trimmer, who also acts as line man.

Mr. Peter English is president of the company, Mr. John J. Holmes vice-president, and Mr. Frank English, secretary, treasurer and general manager. The latter, though still a young man, has had an experience in the business dating from his fourteenth year and to his careful management of the plant, a great share of its success is no doubt due. He has made several valuable improvements, one of them consisting of a line of barbed wire, strung along the top of the pole line and grounded at every fifth pole. The result is that lightning has never caused any damage to the plant.

Buchanan is an enterprising little town 85 miles from Chicago. It has several important manufacturing concerns, such as cabinet works, wagon works, etc., and with the development of its abundant water power, will no doubt become a prominent manufacturing centre of Michigan.

THE GALLIOT ELECTRIC CANAL BOAT PROPELLER.

On the 2d and 3d of October an experimental run of an electrically propelled canal boat was made on the canals of Paris and on the Seine. The system tried was that devised by M. Galliot, the designer of the electric towing system employed at Pouilly, in connection with the firm of Farcot who constructed the apparatus. In the present case the rudder of a canal boat is replaced by a device of the same form and moved in the same way as the rudder. At its upper end it carries the motor, which, through the intermediary of a gear drives the screw situated as far as possible from the stern of the boat. The limited length of canal locks, of course,



FIGS. 1 AND 2.—THE GALLIOT ELECTRIC CANAL BOAT PROPELLER.

requires that the present arrangement shall occupy no more space than the rudder at present in use.

The new propeller is mounted on one of the canal boats of the Havre-Paris-Lyon Company. It is calculated for a speed of 300 revolutions, the gears having a ratio of 37 to 11. The engravings, Figs. 1 and 2 show sectional and rear views of the arrangement. The screw shaft is placed within the box A, carrying at its end a bevel gear, b, gearing with the pinion p keyed to the vertical shaft which is driven by the electric motor, M. The bevel gears are placed in a cast iron box filled with oil. The motor is provided with a Hutin & LeBlanc magnetic screen, designed to suppress sparking produced by the considerable variation to which the motor is subjected in its work. Another important feature is the Farcot magnetic system of suspension, by which the weight of the motor is equilibrated, overcoming friction and avoiding loss of power by hysteresis. The axis of the rudder and the box forming its rear end are made of sheet iron and displace a volume of water almost sufficient to balance completely the weight of

the apparatus. The motor shaft is surrounded by a tube, through which oil circulates to lubricate the gears.

The Galliot screw has an efficiency as high as any other apparatus of the same type and the canal boat having a length of 88 metres and carrying 180 tons is driven at a speed of 85 centimetres per second, an increase of 40 per cent. over the speed which could be obtained with two horses. The electric power expended equals 3,400 watts, or 4.6 horse power. Under favorable conditions a speed of one metre per second was exceeded.

The current was obtained from Laurent-Cély Chloride accumulators which worked admirably. It is proposed to continue these experiments with current obtained from an overhead trolley and experiments with this object in view will soon be undertaken at Perrilly. It is calculated that the feed water required to maintain the levels at the proper height, descending from the level of one lock to that of the other, will give sufficient power to drive dynamos amply able to furnish current for all boats on the canal.

THE BEST METHOD OF TREATING ACCIDENTS.¹

BY P. M. DYER.

Among the subjects coming to the attention of the general manager none is more replete with perplexity and difficulties than the disposition of personal injury claims. Expense of operation can be approximated? cost of construction estimated by the engineer or architect, but when and where accidents will happen, and what they will cost the company, can never be predicted. By the aid of modern inventions the cost of operation has been lessened; but this gain is threatened by the additional expense incident to the increased number of accidents on street railroads operated in the crowded thoroughfares of our large cities.

It is my purpose to explain to you in what manner the North and West Chicago Street Railway Companies attend to personal injury cases, commencing with the accident and following the theme to the final disposition of the claim. These two corporations carried 167,000,000 passengers during the year ending December 31, 1893, and upon the claim department devolves the duty of investigating all accidents and the making of settlements, or preparation of the defence, in all claims that spring from this great traffic. One claim department does this work for both roads.

The working force consists of a medical staff and a sufficient number of investigators, all under the direction of the chief adjuster, who reports to the general counsel of the two companies. For the purpose of this article the work of the claim department may be divided into three periods, each separate and distinct from the others, as follows: First, investigation; second, negotiation; third, litigation.

First, as to investigation. The work of this period begins immediately after the accident and continues until there has been secured a full and accurate account of the accident, with reliable information as to the nature and extent of the injuries to the person. Employees have been instructed to notify the claim department of the occurrence of an accident on car or train, giving circumstances of the same, nature of injuries to and residence of the injured, and as far as possible to secure the names of the witnesses. When this has been accomplished and the injured one has been placed in the charge of a physician or the police, the car or train may continue its journey. In the meantime a representative of the claim department will proceed with all possible dispatch to the scene of the accident. If the injured person has not yet been removed, he must see that conveyance is provided to the hospital or to the home.

These companies usually bear the expense of temporary medical care and transportation, without regard to liability, believing such attention is appreciated by the injured and the community at large. In all cases of personal injuries, it is the duty of the medical staff to secure the privilege of an examination; the physician making the same to avoid any assumption of responsibility for the treatment, but to fully ascertain the nature and extent of the injuries, and to obtain, if possible, a concurrence in his report by the attending physician.

All employees witnessing accidents are required to make written statements of the circumstances of the same on printed forms provided for that purpose, attaching the names and places of residence of all witnesses. This report must be completed and given to the foreman before the employee finishes his day's duties. These reports are forwarded to the claim department without delay, and when received, circular letters containing printed interrogatories are sent to each witness. If the seriousness of the accident demands it, interviews are had with the witnesses. That the claim department may be kept fully advised from time to time as to the condition of persons injured on these roads, they are occasionally visited during the period of recovery by the investigators assigned to those cases. In Chicago, all hearings before the coroner are had immediately after the accident, and the verdict of the coroner's jury is usually rendered on the day following the death. It is the policy of these companies to secure the presence

1. A report presented before the American Street Railway Association, Atlanta, Oct. 17-19, 1894.

of their witnesses at the hearing before the coroner, and obtain stenographic minutes of the proceedings. Thus, in a comparatively short time, the claim department will have collected much information as to the condition of the injured, and the circumstances of the accident. We may now consider the work of the first period completed.

The reports relating to an accident could now be filed away, perhaps forever, if it were not for the industry of some claim lawyer or other hustler who persuades the injured to make a demand on the company for compensation. The making of a claim leads us to a consideration of the second period, that of negotiation. Demand being made for compensation, it becomes the duty of the chief adjuster to place before the general manager or general counsel all facts within his knowledge bearing on the claim, for a decision as to liability, and the naming of the maximum sum to be paid, if a settlement is deemed advisable, the claimant being promptly informed of the decision. As to the negotiations preceding a settlement, I need say but little. They are usually conducted by the chief adjuster on the part of the company. If not successful the period of negotiation will end, usually to be followed by litigation, the third and last.

After the commencement of suit all witnesses are again located by the claim department, and thereafter located at stated intervals until the time of the trial, and if possible additional witnesses are found to strengthen the defense. Success in defending suits arising from personal injuries, largely depends on the character of the work done during the period of investigation. The officers of these companies believe in the thorough investigation of all accidents, if possible the settlement on a reasonable basis of all valid claims, in vigorously contesting fraudulent demands, and that prompt settlements are for the best interests of their companies.

In conclusion, I will say that the time is at hand when all railroad corporations must be prepared to resist claims in a large percentage of their accidents. To promptly prepare to do this is the part of wisdom, when considered from a financial standpoint, usually the determining consideration in corporate management.

COLLEGE NOTES.

THE GLASGOW AND WEST OF SCOTLAND TECHNICAL COLLEGE.

We have before us the calendar of the above institution for the session of 1894-5. The object of the college is to afford a suitable education to those who wish to qualify themselves for following an industrial profession or trade, and to train teachers for technical schools. Its scope is therefore very large and the calendar contains upward of 280 closely printed pages. Both day and evening classes are provided.

Prof. Andrew Jamieson occupies the chair of Electrical Engineering, and Prof. James Blythe that of Natural Philosophy.

SOCIETY AND CLUB NOTES.

HENRY ELECTRICAL CLUB.

THIS club which was the outcome of the course of lecture delivered in New York at Cooper Union last winter, in connection with the University Extension and under the auspices of Columbia College, has just completed arrangements with the American Institute of the City of New York to become the Electrical Section of the same. Hereafter it will meet every Wednesday evening, at the rooms of the Institute, 111-115 West Thirty-eighth street. The object of the Club is to hold informal discussions and have papers on practical subjects presented. In addition, one lecture will be given each month, by some specialist on an announced subject. The officers for the ensuing year are: President, W. H. Freedman, E. E.; first vice-president, L. H. Laudy, Ph. D.; second vice-president, Max Osterberg, E. E.; secretary, George Whitefield.

NATIONAL ELECTRIC LIGHT ASSOCIATION.

The selection of Cleveland as the place of holding the next annual convention has been confirmed, and it has now been definitely settled to go there on February 19, 20 and 21, 1895. Secretary Porter says that the prospects are already bright for a good meeting.

BROOKLYN INSTITUTE OF ARTS AND SCIENCES.

On Monday, October 29 the Department of Electricity of the Brooklyn Institute listened to the third lecture of the course on "Electricity and its Applications in the Arts and Sciences," by Prof. Wm. A. Anthony.

MR. JOSEPH SACHS is to lecture before the the New York Electrical Society at Columbia College on Thursday, Nov. 1, at 8 p. m., on "Is there a Solution of the Electric Conduit Railway Problem?" The lecture will be illustrated with lantern slides, and a useful discussion is expected.

LEGAL NOTES.

THE MAITLAND-GIBSON ELECTRIC FIXTURE SUIT.

JUDGE ACHESON SUSTAINS THE OPINION GIVEN BY THE LOWER COURT.

Judge Acheson filed an opinion in the United States Circuit Court of Appeal last week sustaining the finding of the lower court in the suit of George Maitland against Alfred C. Gibson, trading as the Gibson Gas Fixture Works, for alleged infringement on the complainant's patented improvements in gas and electric light fixtures combined. The case was heard last month upon appeal of Mr. Maitland from the decision of Judge Dallas in the Circuit Court, under which it was held that no infringement had been made, and the bill of complaint was dismissed. Attorneys D. H. Driscoll and R. N. Dyer, of New York, represented Mr. Maitland, and Lawyer Hector T. Fenton appeared for the Gibson Works. In the opinion Judge Acheson said: "After a thorough examination of the record we fail to discover any ground for disturbing the decree dismissing the bill of complaint. We all concur in the conclusions of the Circuit Court and in the reasons therefor expressed in its opinion. That opinion is so full and satisfactory that any further discussion of the case is needless. We, therefore, adopt the opinion of the court below as our own, and upon it we affirm the decree."

LITERATURE.

The Handbook of Standard or American Phonography. By A. J. Graham, A. M. New York, Andrew J. Graham & Co. 441 pp. Cloth. Price \$2. (New Edition.)

This invaluable manual of shorthand has already passed through several editions, and now appears in new and revised form for the benefit of thousands of members of the younger generation. The Standard system to which Mr. Graham gave so much of his life has long been employed in the Houses of Congress, in State Legislatures, in law courts innumerable; it has preserved the sermons of Beecher, the speeches of Phillips and Depew; and now, thirty-five years after its first publication stands ready for all the requirements of the present time. It cannot be too strongly recommended.

Electric Lighting Plants. By W. J. Buckley. Chicago. Wm. Johnston Printing Co., 1894. 275 pp. Cloth 12mo. Price \$2. Paper \$1.

This is a remarkably useful, helpful and handy little book. Its pages are brimful of just the kind of data that an intending purchasing of all classes of apparatus for an electric light plant needs. It is true that Mr. Buckley, as a Fort Wayne official, bases many of his statements upon data from that company's machinery, but he is in no wise partisan or unfair. The book goes practically into every detail of electric light work except underground construction, and the statistics are furnished in most welcome fullness and minutiae. We have ourselves tested its figures in various places, and find them entirely trustworthy. Many electricians and engineers will find it very convenient to have in printed form the information that the book contains. There are numerous diagrams of value, and tables in great variety.

Electrical Papers. By Oliver Heaviside. 2 Vols. Cloth. 8vo. Illus. pp. 560 and 587. New York. Macmillan & Co. Price, \$7.

We have recently reviewed in these columns Mr. Heaviside's work in elucidating the theory of electro magnetism from the Maxwellian standpoint. These volumes go over the same ground, but we have in addition a vast amount of matter consisting of articles written for different publications during the last twenty odd years, the earlier contributions being chiefly telegraphic. There is much here that is very interesting. Mr. Heaviside's work is often caviar to the general, and is not presented always in the best manner. We have heard of an editor who said he could reprint the same Heaviside article three times under different headings without anybody detecting the fraud, but perhaps that was humorous exaggeration. Mr. Heaviside has never sought to be popular and he is none the worse for that. He has done so much to hammer out the true meaning and value of the modern electro-magnetic theory that he should be permitted to express himself in his own way, mathematical and ultra symbolic though it be. To our mathematical readers we may say that the volumes are on the whole thoroughly well worth their careful perusal.

THE ELECTRICAL ENGINEER.

[INCORPORATED]

PUBLISHED EVERY WEDNESDAY AT

203 Broadway, New York.

Telephone: 1323 Cortlandt.

Cable Address: LENGINEER.

GEO. M. PERKINS, President.

F. R. COLVIN, Treas. and Business Manager.

Edited by

T. COMMERFORD MARTIN and JOSEPH WETZLER.

Associate Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue, Boston, Mass.

Western Editor and Manager, C. KAMMEYER, 1439 Monadnock Building, Chicago, Ill.

New York Representative, 203 Broadway, } W. F. HANES.
Philadelphia Representative, 216 Betz Building, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada, - - - - -	per annum, \$3.00
Four or more Copies, in Clubs (each) - - - - -	2.50
Great Britain and other Foreign Countries within the Postal Union " - - - - -	5.00
Single Copies, - - - - -	.10

[Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1893.]

EDITORIAL ANNOUNCEMENTS.

Addresses.—Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of THE ELECTRICAL ENGINEER. Communications for the attention of the editors should be addressed, EDITOR OF THE ELECTRICAL ENGINEER, 203 Broadway, New York City.

VOL. XVIII. NEW YORK, OCTOBER 31, 1894. No. 339.

CONTENTS.

EDITORIALS :—	PAGE
Electricity vs. Gas.....	358
American and English Railroads.....	359
High Efficiency of Vacuum Tube Lighting.....	360
ARTICLES :—	
On Economy in Conductors and the Limitations in the Applicability of Kelvin's Law.....	W. A. ANTHONY. 349
Electrical Machinist Practice.—VII. (Illustr.).....	J. F. HOBART. 351
Magnetic Leakage in Dynamo Electric Machinery.—VIII. (Illustr.).....	A. E. WIENER. 353
On Persistent Electrical Oscillations and their Effects (Illustr.).....	H. EBERT. 354
The Buchanan, Mich., Electric Light Plant (Illustr.).....	355
The Gallot Electric Canal Boat Propeller (Illustr.).....	356
"The Best Method of Treating Accidents.".....	P. M. DYER. 356
Starting the Watervliet Arsenal Electric Plant (Illustr.).....	356
NEWS AND NOTES :—	
Brooklyn Bridge Cars Lighted by Electricity.....	352
Recognizing Railway Efficiency and Courtesies.....	355
COLLEGE NOTES :—	
Glasgow and West of Scotland Technical College.....	357
SOCIETY AND CLUB NOTES :—	
Henry Electric Club.....	357
National Electric Light Association.....	357
Brooklyn Institute of Arts and Sciences.....	357
New York Electrical Society.....	357
LEGAL NOTES :—	
Maitland-Gibson Electric Fixture Suit.....	357
LITERATURE :—	
Graham's "Handbook of Standard or American Phonography".....	357
Buckley's "Electric Lighting Plants".....	357
Heavilside's "Electrical Papers".....	357
TRANSPORTATION DEPARTMENT :—	
The Poughkeepsie City and Wappingers Falls, N. Y., Electric Railway (Illustr.).....	360
The Electric Lighting Plant at Rumson Neck, N. J. (Illustr.).....	362
Brake Shoes.....	D. F. HENRY AND P. EVANS. 362
Philadelphia Trolley "Smoker".....	363
LETTERS TO THE EDITOR :—	
Storage Batteries and Gold Medals.....	R. MACRAE. 363
Answer to Mr. Brackin's Criticism on "Chips from a Storage Battery Workshop".....	J. K. PUMPELLY. 363
INVENTORS' RECORD :—	
Classified Digest of U. S. Electrical Patents Issued October 16 and 23, 1894. 364	
OBITUARY :—	
J. B. McGiffert.....	365
A. F. Kirby.....	365
PERSONAL :—	
Mr. Louis C. Mouquin.....	366
TRADE NOTES AND NOVELTIES AND MECHANICAL DEPARTMENT :—	
Franklin Institute Report on the Chloride Accumulator—Ohio Storage Battery Co.....	366
Double Discharge James Leffel Turbine (Illustr.)—Electrical Supplies for the U. S. Signal Office.—Aylesworth & Jackson.—Stillwell-Bierce & Smith-Valle Company.—Montreal Notes.....	367
G.E. 1 H. P. Induction Motor (Illustr.)—Steel Rails Wanted.—New York Notes.—New England Notes.—The New Desk Light (Illustr.).....	368

ELECTRICITY vs. GAS.

SEVERAL of our electric light friends have spoken to us or written to us recently in regard to the vogue enjoyed by the Welsbach gas burner. They say that it is being actively pushed and introduced, and that if the present rate of adoption should continue it will make serious havoc with incandescent lighting. We are informed that in some cities as many as 10,000 have been installed and that in a great many instances they have superseded electric lights. The question arises, therefore, whether the competition of such burners is a permanent element to deal with, and if so, what is the best plan of meeting it satisfactorily.

We can easily understand the anxiety of our friends, but it does not seem to us that the situation is in anywise as serious as they imagine. It should not be forgotten that it is the same old gas, that the light remains a naked light, and that the results of combustion remain just as deleterious and poisonous as ever. It is pointed out by an English contemporary that such lights produce an amount of carbonic monoxide gas that is quite poisonous, being 1 part in 4,500 of the atmosphere, where 1 part in 10,000 is to be avoided. The Frankfort *Zeitung* on this point says:

"The weighty question—what influence the consumption of lighting gas exerts on the health in inhabited rooms—has lately been looked into by the French physiologist, Grehant. This investigation gives us most noteworthy results in relation to the now so extensively used Auer (Welsbach) light. Grehant gathered in a holder of 150 litres capacity the products of combustion of ordinary lighting gas after using burners of the old system and then the Auer burner. The analysis gave in the first case the smallest trace of carbonic oxide gas, but in the case of the Auer burner, carbonic oxide gas was found in considerable quantity, the exact proportion being 1 to 4,500, and this was accompanied by an almost equal quantity of fire damp gas."

This is interesting and may be supplemented by the following authentic data:

Illuminant.	Cubic feet of carbonic gas produced.	Cubic feet of air vitiated.	Heat evolved in lbs. of water raised to 10° F.
Electric Light.....	None.	None.	183½
Common Gas.....	3¼	848¼	278½
Paraffine Oil.....	4½	484	362
Wax Candles.....	6	632¼	388

It follows that not only is the combustion of gas hurtful to human beings but that books, furniture, tapestry, carpets, decorations, etc., are all injured. In most of these respects, the use of the Welsbach burner makes no difference except to enhance the harm done. If our readers wish to make the experiment, let them try how long they can stay in a 10 x 10 closed room with two Welsbachs and then with two electric incandescents.

It is claimed that the Welsbach burners and their like reduce the gas bills. If this be true, then the gas companies cannot be very ardent supporters of them. But the contention seems reasonable that with less gas consumed, less light is given out, especially when the hoods have become jaded and faded. At best they are not pretty; at worst their ghastly gleam suggests the whited sepulchre.

As we have intimated, the hooded burner is not a permanent element in lighting, but perhaps it has to be met meantime. To that end we would suggest that as good a service as possible be rendered by the local companies. Why are not more incandescents of high efficiency used?

Why burn low efficiency lamps that look like red hot hair pins and are probably not able to give 5 or 6 c. p. We have even heard of companies that having taken in their old lamps, have sold them again at a reduced price, for further use. Can that be good policy? It must assuredly be better to have all the lamps on the circuit burning cheerily and brightly so that everybody who sees them wants to have some. Even if they do not last as long, the difference will be offset by the greater demand and the greater satisfaction, as well as the increased alacrity with which lighting bills are paid.

AMERICAN AND ENGLISH RAILROADS.

One of the most interesting and instructive contributions to the magazines, for a long time past, is to be found in the article on "Railroad Travel in England and America," in *Scribner's* for October and November, by Col. H. G. Prout. It is not our intention here to review the article as a whole, but we cannot refrain from expressing our admiration of its clear, intelligent and sympathetic treatment of a great subject. Probably the period of steam travel in England will never have a better presentation, and it is perhaps as well that Col. Prout should have visited England now, for if there be any one thing that it is clear it is that very soon a large proportion of the English railroads will be operated electrically. It is impossible for the demonstrations with electricity to be made much longer without having their due effect, even despite the English stolidity and conservatism. Col. Prout gives many figures that show how ripe England is for the change, but none are more impressive than those dealing with the shortness of the roads, the magnitude of the investment and the immensity of the traffic.

For example, in 1892 the English railroads carried 67,200 passengers per mile of railroad worked; ours carried only 4900. English railroads have cost about \$227,000 per mile; ours have cost but \$63,700. English roads carry annually 1,344,000,000 passengers; ours carry 843,000,000. English roads carry 15,500 tons of freight per mile worked; ours carry 4,382 tons per mile. The shortness of the roads is shown by the fact that the enormous traffic in England was handled by $22\frac{1}{2}$ trains each way over every mile daily, while here the movement equaled only $6\frac{1}{2}$ trains each way every day. Now it would seem that a large portion of the English system must be working to its fullest capacity under steam conditions, and as every increase in facilities is attended with frightful expense, it would appear that resort must soon be made to an individual car unit service, each car being virtually its own motor, so that instead of depending on a train schedule, the road will be in ceaseless use and the headway will be like that of street car lines. It is a patent and obvious fact in America that the steam roads simply cannot stand the trolley competition, and it is a natural inference that as a large proportion of the English railroads are devoted to the business that our trolley roads do, they will and must find it economical and profitable for all local traffic to adopt the trolley system and abolish the ponderous locomotive as well as the time-honored train crew. Even should not the steam locomotive go, its place must be taken by the electric. The remarkable report just made by Mr. W. B. Parsons to the New York Rapid Transit Commissioners comes in time to confirm many of

Col. Prout's statements as to urban travel and to strengthen our conviction as to what is awaiting in the near future, especially in England with its short lines and dense populations. Mr. Parsons, speaking of the electric locomotives running in England, says that for economy they make a very favorable comparison with steam locomotives. He mentions also two that have made 49,580 miles, and 59,221 miles, respectively, without any repairs. It would be interesting to see the figures of steam locomotives for corresponding mileages.

It may be pointed out that the adoption of the trolley system on the English roads is free from all the objections raised against its use on streets, especially as nearly every English crossing is made above or below grade. Another feature is that costly and heavy construction would no longer be necessary. Cars running singly at frequent intervals do not require the massive tracks, bridges, etc., that trains weighing hundreds of tons do. Even if the trolley were restricted to slower travel, there is an incalculable amount of traffic to be done cheaply at those lower speeds. Col. Prout elucidates this in his article, and says: "A man earning \$1 a day can wait half a day to start and add half a day to the length of his journey to save \$1.10 in fares, and still make 10 cents by the delay." Exactly, and for that reason it is easy to ship people on board incessantly running trolley cars between London and Manchester or between New York and Philadelphia, carry them at rates that are impossible on the steam roads, make money, and give satisfaction. Cheap transportation lies at the basis of modern civilization, and the speed is a secondary element. Col. Prout says that the passenger traffic on the steam roads of the United States pays 2.14 cents per mile. Trolley road managers as a matter of course carry people for 5, 7 and 10 miles for 5 cents and make it pay, and that is why so many of the steam roads cannot "buck" against them. In a country like England, trolley roads may be made to feed the old steam roads, also; and we believe that in this country the shrewder steam railway managers will soon be trying the effects of such a plan, calling in the transverse lines to offset the evils of the parallel.

HIGH EFFICIENCY OF VACUUM TUBE LIGHTING.

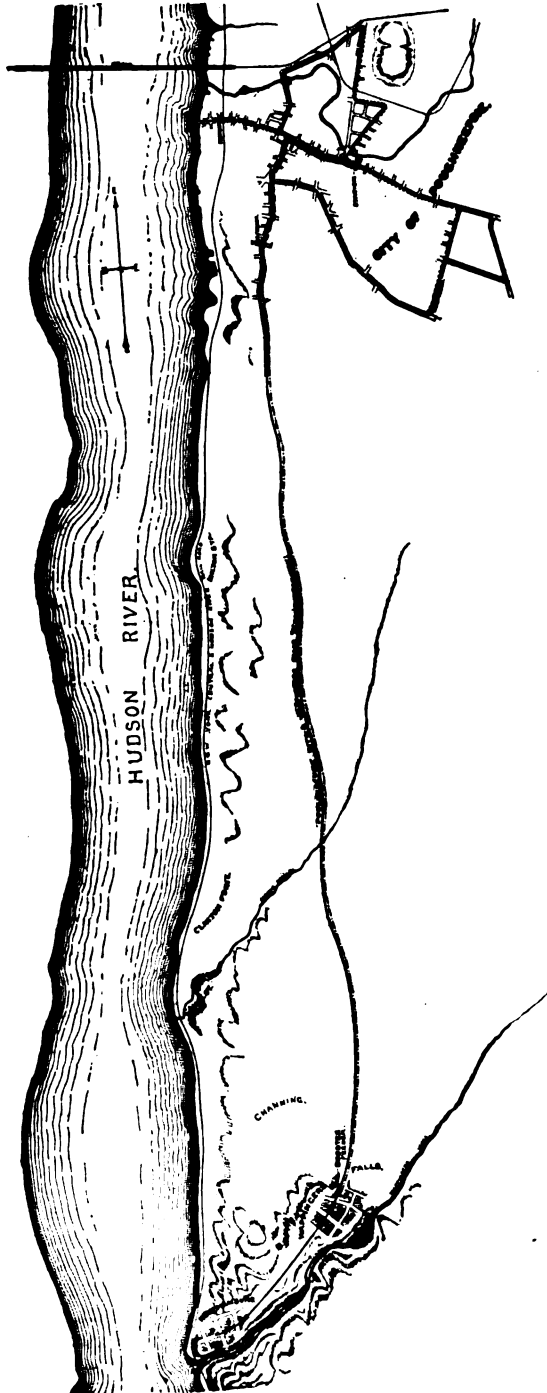
It is gratifying to note that numerous investigators and experimenters have taken up the subject of the production of light through the medium of vacuum tubes with the aid of alternating currents of high frequency. The production of light without heat is, of course, the ultimate object of these experiments and to determine, therefore, just what proportion of the energy is converted into light by this method is of the first importance. We therefore print in another column an abstract of a very important paper by Professor H. Ebert, in which he gives the results of actual measurements made on vacuum tubes. From these we gather that the lamp experimented with, having a luminosity of one-thirtieth to one-fortieth of the amyl-acetate standard (about one standard English candle), absorbed energy equal to about one-millionth of a watt, and that the vacuum tube consumed from 1,500 to 2,000 times less energy than the amyl-acetate standard. As the efficiency of the incandescent lamp is probably five times as great as that of the amyl-acetate lamp, it may be fairly assumed, if Professor Ebert's calculations are correct, that vacuum bulb lighting possesses many hundred times the efficiency of the incandescent lamp. The rules given by Professor Ebert for obtaining the best luminous effects from electric oscillations of high frequency are direct deductions from the work of Mr. Tesla as laid down in his lectures on this subject, and we are glad to see the latter confirmed independently.

ELECTRIC TRANSPORTATION DEPARTMENT.

THE POUGHKEEPSIE CITY AND WAPPINGERS FALLS, N. Y., ELECTRIC RAILWAY.

In the conversion of this road from horse power to electric traction, it was deemed advisable, in view of the substantial character of the horse stables and car house to utilize the existing buildings. To this end, the old brick horse stable, 68 ft. square

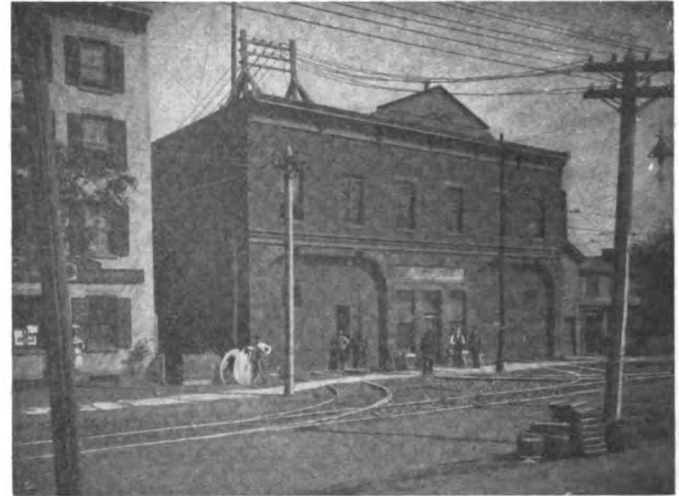
200 K. W. General Electric multipolar generators, each of which is direct connected to a 800 H. P. Ball & Wood compound condensing engine. The foundations for these units are of extremely heavy masonry. As in the boiler room, there is here space for duplicating the plant. The condenser, feed water heater and boiler feed pumps are located in the rear of the engines and close to the



ROUTE OF THE POUGHKEEPSIE AND WAPPINGERS FALLS ELECTRIC RAILWAY.

and 25 ft. high, was remodelled by the removal of the interior studding and beams, and the building of a central 12" brick partition. The two rooms formed by this partition wall have been utilized for boilers and engines, respectively.

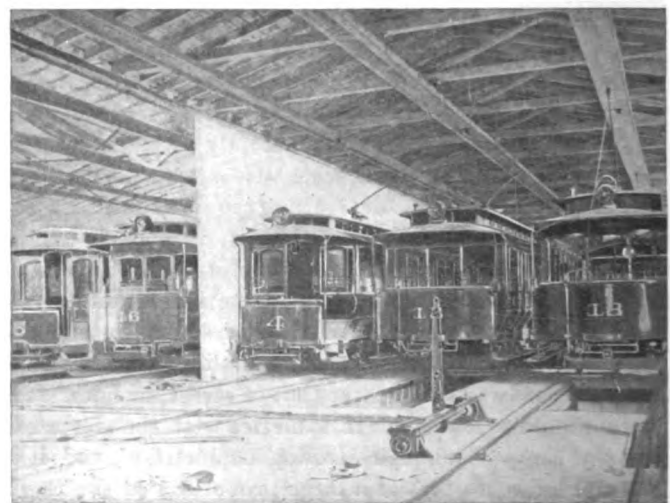
The boiler room contains two 800 H. P. Stirling boilers, and is of capacity sufficient for a duplicate battery. It is floored with brick laid in cement and grouted. In the engine room are two



THE CAR HOUSE—EXTERIOR VIEW.

division wall. All of the piping is carried in pipe channels below the floor line, the floor being composed of 12 inches of concrete surfaced with an inch of Portland cement. The pipe channels are provided with cast iron covers, set flush with the flooring, this arrangement affording ready and convenient access to any part of the piping system.

The switchboard is built of black enameled slate slabs of the General Electric panel type. The dynamo leads run beneath the floor in vitrified pipe conduits. In general effect the interior of the power house is extremely pleasing; the walls are painted in buff, and in the engine room there is a Portland cement wain-



THE CAR HOUSE—INTERIOR VIEW

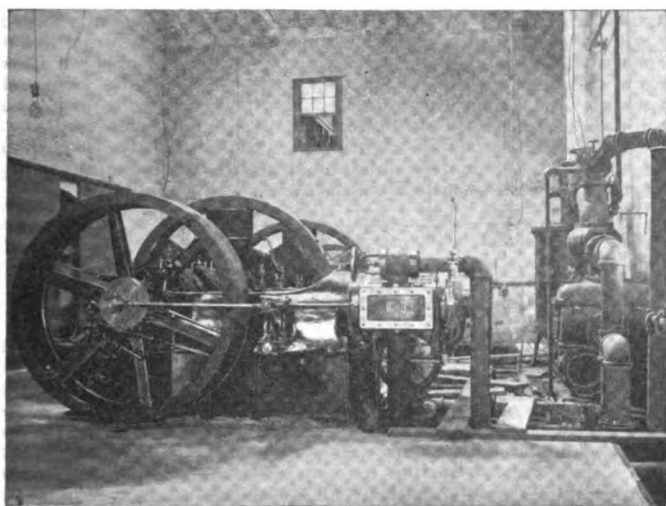
scotting, capped with a 3" pine nosing. There is an abundance of light and ventilation, and the metamorphosis of the old stable is so complete as to defy detection.

The old car house has been entirely remodeled and largely increased in space and convenience. The roof was raised four feet, an extension of 80 x 90 ft. added, and an entire new front con-

structed, containing superintendent's offices and waiting room on the first floor, with large and commodious general offices on the second floor, and the storage rooms in the basement. The repair shop is situated in the basement and provision has been made for the comfort of the employees by devoting a suitable room to their exclusive use. The superintendent's office and the waiting room are handsomely finished in paneled cherry wainscoting with ornamental steeled-pressed walls and a delicately tinted ceiling.

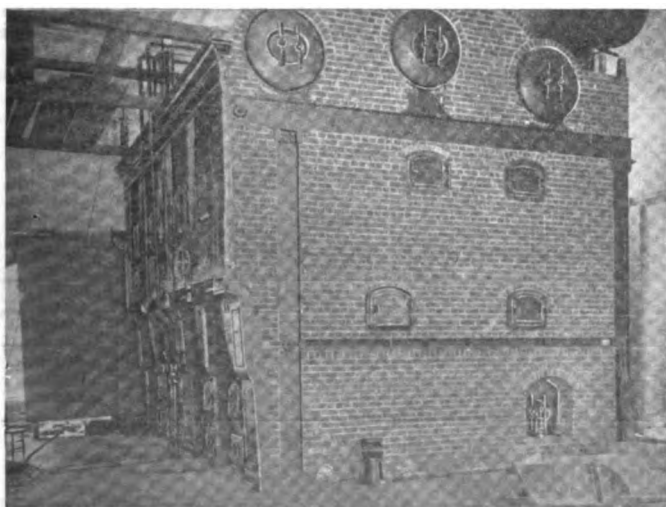
The entire car house is in practically two sections, the longer being 194 ft. in depth and the shorter 90 ft. There are six tracks in all, four having direct access to the street, the other two being spurs connected with the Hathaway transfer table which cuts across all six tracks near the transverse centre of the building.

Several car pits are provided under each track. A convenient place for coal storage is provided under the west car house, giving ready access to the boiler room. This provides a space for a storage of upwards of 1,000 tons of coal. Messrs. Berger & Slater executed the mason work, while Mr. Isaac G. Manning of Poughkeepsie, attended to the wood construction.



G. E. DIRECT CURRENT GENERATORS AND BALL & WOOD ENGINES.

The track system consists of 10 miles of single and double track, laid through the streets of the city. A spur 10 miles in length reaches from Poughkeepsie along the Ridge Road to Wappingers Falls and thence to New Hamburg. The heaviest grades within the city limits occur on that portion of the line leading

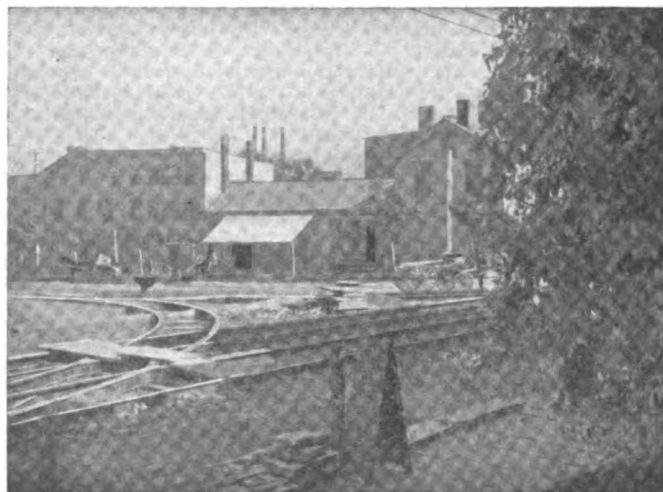


THE STIRLING BOILER PLANT.

from the steamboat landing on the Hudson River, near the New York Central depot, up Main street for about one mile. The grades here vary from 5 to 8½ per cent. The track on Main street is laid with the best 90 lb. girder rail, rails and special construction being furnished by the Johnson Company. The remainder of the track is laid with 60 lb. and 56 lb. T-rails. The track is

bonded throughout with two No. 0 B. & S. copper wires, riveted in place.

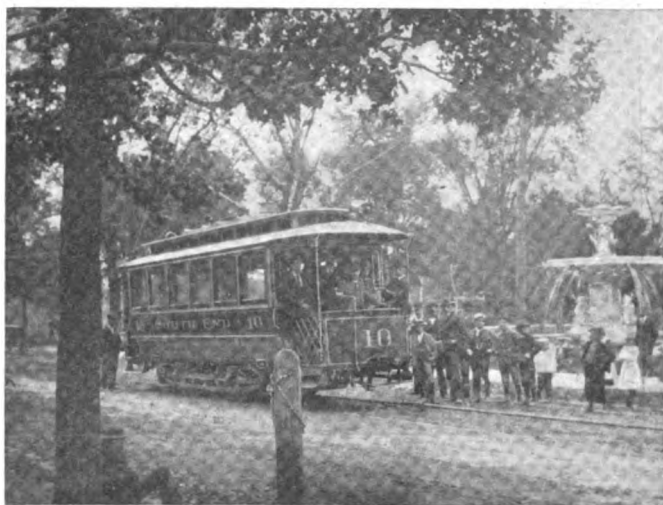
The line leading from Poughkeepsie to Wappingers Falls is nearly straight in its course, the grades varying from 1 to 8 per cent. Between Wappingers Falls and New Hamburg, where the



CURVE CONSTRUCTION, POUGHKEEPSIE.

track leads down toward the Hudson River, the grade is as heavy as 9 per cent.

The line construction consists of the usual form of stout octagonal hard pine poles with treated butts. These are set up on Main street and Market street, the remainder of the poles throughout being round, shaved and painted.



VIEW OF ROAD ON PUBLIC SQUARE, POUGHKEEPSIE.

Span wire construction is used throughout the city; bracket construction is used on the line leading to Wappingers Falls and New Hamburg. The trolley wire is No. 0 B. & S., supported by 5/16" stranded steel span wire. The line material is of the H. W. Johns manufacture.

Feeders of No. 0000 B. & S. wire are placed as required for electric distribution within the city limits. An interesting feature of the feeding system is the application of the booster idea to the long distance feeder from the power house to Wappingers Falls. The feeding point is eight miles from the station with a 9 per cent. grade two miles beyond the end of the feeder. By the use of the booster it is possible to properly supply this section of the line through two No. 0000 B. & S. wires. The Woodbridge & Turner Engineering Co. constructed the line work, while the track construction including bonding was under the charge of Supt. C. M. Davis, of the railway company.

The rolling stock equipment consists of eight closed motor cars, 18 feet in length, built by James A. Trimble, of New York; ten open motor cars, 30 feet in length, built by the American Car Co. of St. Louis, Mo.; and two closed vestibule cars, made by the

latter company. All motor cars are mounted on the latest type of Peckham cantilever truck. The electric equipment of the cars consists of two G. E.-800 motors per car, with type K series-multiple controller. All cars are fitted with the Star electric headlights, and all closed cars with the American Car Heating Company's electric heaters. Several of the accompanying views were taken while the construction was under way. Details shown in this way are frequently more interesting than photographs of the completed construction could ever be. The surveys were made by Messrs. Lawlor & House, Civil Engineers, of Poughkeepsie. The entire engineering supervision of the work has been under the charge of Mr. J. H. Vail, Chief Engineer of the Electrical & Mechanical Engineering & Trading Co., of New York, from whose offices all plans and specifications were issued.

The new electric railway will supplant an extensive passenger and express stage business between Poughkeepsie and Wappingers Falls. It furnishes convenient transportation facilities between the river front and the higher urban localities, such as Vassar College, the Seminary, the Driving Park, the Insane Asylum, the P. & E. R. R. depot, and the cemetery. The same accommodations are offered at the New Hamburg end of the line, which reaches down to the river front.

Maj. J. W. Hinckley, the enterprising and energetic president of the railway company, has taken great personal interest in the construction of the entire system, and the citizens of Poughkeepsie will be largely indebted to him, as the means of furnishing in their city a first class electric railway system.

THE ELECTRIC LIGHTING PLANT AT RUMSON NECK, N. J.

AN interesting and highly successful installation of an alternating current system, comprising both overhead and underground construction, has recently been completed by the Electrical & Mechanical Engineering & Trading Co. for the Rumson Improvement Co., at Rumson Neck, N. J.

The station equipment consists of one horizontal tubular boiler 66 inches in diameter by $17\frac{1}{2}$ ft. long, containing 100 3-in



UNDERGROUND DISTRIBUTION AT RUMSON NECK, N. J.

tubes 16 ft. long; one Armington & Sims engine; and one Westinghouse 1100-light 1000 volt alternator; the whole being placed in a neat brick power house, which contains also the water-works plant. The arrangement of the steam and exhaust piping has been so planned as to admit of the use of the boiler, flues, feed-water heater and pumps for either pumping water into the stand pipe or for operating the dynamo; thus making a complete combined waterworks and electric lighting plant. The switchboard is of Italian marble, mounted upon an angle iron frame, and contains requisite apparatus of the best types. A recording wattmeter in the station registers the daily output.

From the station a pole line extends southward to the Ridge Road, a distance of 2,800 ft. At this point the line divides, one leg running West about three-quarters of a mile, the other extending Eastward for double this distance. On the Eastern leg near the junction, a 3,200 ft. spur reaches out to the Northward. At the end of each leg the conductors are carried down into a man-hole, which marks the beginning of the underground line. The total length of pole line is 16,500 ft., of which 8,000 ft. is carried upon the poles of the Rumson Improvement Co., the remainder being supported on cross-arms placed on the poles of the N. Y. & N. J. Telephone Co., six feet below the telephone wires.

The underground system, with a total length of 5,000 ft., is mainly upon private property. Large and very flexible copper

cables are employed, covered with Habirshaw Para rubber, outside of which are three heavy braids, treated with compound. Each cable is of single polarity, and is drawn through a double thickness of the Interior Conduit & Insulation Co.'s telescopic tubing. These tubes are bunched in an iron pipe, the latter provided with screwed joints, put together as if intended for conveying steam. A complete iron-armored watertight conduit system has thus been obtained, showing extraordinarily high insulation (30 megohms) between the walls of the conduit tubing, and an entire absence of inductive effect. With such good insulation the covering of the wire is almost superfluous, and is employed merely to render assurance doubly sure. The small drop—calculated to not exceed 2 per cent. at full load—is accounted for the large cables employed, the size ranging from No. 2 to No. 0 B. & S.

In addition to the lighting system, a ten-wire telephone cable occupies the same conduit, and communication may be carried on when the lighting plant is in full operation, so complete is the neutralizing effect of the opposing polarities of the wires.

Manhole junction boxes have been placed at intervals of 500 feet, this being found most expedient for drawing in cables and facilitating condensation drainage. These manholes, with few exceptions, are of iron, with double covers and hermetically sealed.

The accompanying illustration shows in detail the method of construction, together with the rope for hauling in cables. Close up to the iron pipe appears the outer layer of the telescopic tubing. The apparently crooked joint in the pipe is no joint at all, the pipes having been butted together, but not yet coupled.

This plant has been in nightly operation since July 4, without the slightest defect developing on either the underground or any part of the work installed.

BRAKE SHOES.¹

BY D. F. HENRY AND POWELL EVANS.

I believe in standards throughout; but now wish to call your special attention to the subject of the shape and material for brake shoes. Brakes are applied to the track as well as the wheel; but as the latter practice, with few exceptions, is the rule, what follows has special reference to it. The steam railways have reduced the parts of their brake-gear to a standard of shape—the beam, link, release spring, hanger, clevis and shoe. They have found designs good enough for all to use, and so good that no one road seems able to improve upon them.

Having decided upon these standards, they specify them when buying rolling stock, get them, and use them. Why should not our various truck manufacturing companies use a standard brake attachment; and if they can, why do we not decide upon one, and insist upon its use?

As regards material, steam railways are still undecided; but are unanimous on one fact, viz.: that the best thing for one road is best for all. Is this not true also among our roads? I will assume here that it is.

The most reliable results obtained experimentally by the use of different shoes on chilled wheels and with different brake arrangements at the present time in hand, are those obtained by the Pennsylvania R. R. Co. (which furnishes the information) in various tests conducted during the past two years.

In the trials made to compare the use of one brake shoe per

TABLE I.

Cast Iron Shoes. Pounds of Resistance.	Composite Shoes. Pounds of Resistance.	Steel Shoes "Z." Pounds of Resistance.	Steel Shoes "M." Pounds of Resistance.	Steel Shoes "D." Pounds of Resistance.
Average.	Average.	Average.	Average.	Average.
2439.86	2355.70	1772.85	2076.90	2049.86
Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
100	96.58	72.68	85.15	84.02

BRAKE RESISTANCES.

wheel with two brake shoes per wheel, all using long shoes, the sliding of the wheels was somewhat more with two shoes per wheel, but it was mostly on the last pair of wheels. It will be noted that there is practically the same efficiency in these two methods of braking.

Shoes of different lengths show about the same results. It was noticed that the riding of the cars during the stop was much better with two brake shoes per wheel than with one brake shoe per wheel, due apparently to the fact that the application of the

1. Abstract of a Paper read before the American Street Railway Association Atlanta, Ga., Oct. 17-19, 1894.

second brake beam to each pair of wheels partly counteracted the tilting of the trucks caused by the outside suspended beams when only one pair of shoes is used per wheel in this manner.

The experiments on retarding power with uniform pressures by the use of cast-iron, steel and composite shoes with one brake shoe per wheel have been reduced to actual retardation in pounds by the brakes during the stop, and the results are given in Table I.

In calculating this retardation the weight of the train and the weight of the wheels, together with the speed, have been taken into consideration, and the total energy of motion calculated by

TABLE II.

Kind of Shoe.	Wear of				Relative Distance Run after Application of Brakes. Taken from other tests.	Remarks.
	Shoes.		Wheels.			
	Pounds	Per Cent.	Reduction in Circumference in Inches.	Per Cent.		
Cast-Iron	94.690	100.00	2.812	100.00	100.00	12 Shoes worn out.
Composite	87.635	89.79	2.343	83.32	103.87	4 Shoes worn out.
Steel " D ".....	5.708	12.06	1.155	82.21	135.33	2 Shoes slightly worn.
Steel " M & D "	10.290	10.79	2.437	86.66	139.04	4 Shoes slightly worn.
Steel " M ".....	4.532	9.57	1.281	91.11	142.69	2 Shoes slightly worn.
Steel " Z ".....	8.194	8.65	2.969	105.58	194.16	4 Shoes slightly worn.

COMPARATIVE WEAR OF CAST-IRON, COMPOSITE AND STEEL BRAKE SHOES.

adding the rotative energy of the wheels to the energy of the train as a whole, and after allowing for the effect of the grade and the effect of the ordinary resistance of the train without the brakes applied, the actual figures of the retardation of the brake shoe against the wheels as an average during the whole distance of the stop has been calculated.

This table presents selected runs for the purpose of making comparisons between runs in which the pressure in the brake cylinder varies between close limits of 39½ minimum and 42 lbs. per square inch maximum. The figures have all been reduced on theoretical basis to 40 lbs. pressure to the square inch, thus giving a number of cases which can be very accurately compared with one another. At the bottom of the table the averages are given with each kind of shoe, and the percentages for comparisons.

Tests were also made to determine the durability of the shoes, and to get a record as to the relative wear of the wheels, and Table II. gives the results, including also a statement of the relative distances run after the application of the brakes, taken from the former tests reported.

Three sets of cast iron shoes were practically worn out during these tests, and one set of composite shoes, while the steel shoes were not much worn. So far as the wear of the wheels is concerned, the results were somewhat contradictory, and inasmuch as a large portion of the wear of the wheels is from the rail, it would be unsafe to ascribe all the difference to the shoes.

PHILADELPHIA TROLLEY "SMOKER."

A few months ago the Philadelphia street car companies began running smoking-cars in response to a popular demand for them. It has been found almost impossible to keep women out of these cars, and, to make matters worse, the smokers, unable to resist the claims of politeness, have been cheerfully surrendering their seats to the women. Things have now got to such a pass that the latter have become masters of the situation. "Day by day," says an observer, "the feminine travel upon the smoking-cars has increased. That man is lucky who can now cling to the edges of the car and fondly hope that he may smoke in peace after the long journey is over and he has reached the secluded precincts of his office or home. The women not only claim the smoking-cars as their own, but they have begun to stare coldly at such men as now venture timidly into the cars which were prepared especially for them." The question whether the men have a right to smoke in a smoking-car in the presence of women has been settled by the latter in the negative, and an offender was actually ejected from one of these cars the other day by a man accompanying an indignant woman. What makes the persistence of the women singular is that the smoking-cars are much less comfortable and attractive than those provided for general use. The Philadelphia newspapers are courageously supporting the men in this emergency, and urging them to stand on their rights. "The women," one newspaper makes bold to say, "must yield the cars to men or they (the women) must learn to smoke."

LETTERS TO THE EDITOR.

STORAGE BATTERIES AND GOLD MEDALS.

THERE recently appeared in some of the electrical journals a report of a Committee of the Franklin Institute recommending that a medal at the disposal of the Institute be awarded to the inventor of a certain type of storage battery. As a glance at this report may lead many to think that this "Committee on Science and Arts" has sacrificed the interests of science to those of the manufacturer of this particular battery, it may perhaps be well to draw attention to some of the statements contained in that report.

In giving reasons for the deterioration of the plates in all lead batteries except in that which the members of that committee consider worthy of their medal, they say: "This disintegration appears to be due largely to the fact that the lead oxide paste placed in the holes is a mechanical rather than a chemical mixture and hence in changing from PbO₂ to PbSO₄ during the action of the cell, the molecules being only related to one another in a fortuitous manner, are easily broken up and thrust apart, etc."

It is here seen that they are careful not to attribute the disintegration of the plate to any one cause. They are quite sure however that the lead oxide paste is a mechanical mixture. If, as they say, the paste changes from PbO₂ to something else, the paste may after all be a chemical mixture. Many books on chemistry treat PbO₂ as a chemical mixture and the committee does not give its reasons for thinking otherwise. Is it a fact that the molecules of PbO₂ are related to one another in a fortuitous manner, or did the committee mean particles of the paste when it used the term molecules? If the molecules are easily thrust apart, would not that facilitate the formation of new compounds?

Then follows the assertion: "This of course limits the life of the battery and its utility for public service." The "of course" argument is scarcely such as one would expect from a committee of the Franklin Institute, and, incidentally, why "public" and not private service? After this follows a description of the process of manufacturing the battery which the committee thinks deserves a medal. This particular process it is claimed, prevents the disintegration of the active material of the plate. The manner in which the process "accomplishes its anti-disintegrating function" is explained as follows: "This provides interstices so that the changes of volume occurring in the chemical reactions of electrolysis may take place without exerting lateral pressure on the crystals or otherwise crowding them into a condition of break-up." This explanation appearing in a trade catalogue would not be apt to command any serious consideration but when a committee on science speaks of changes of volume in chemical reactions of electrolysis crowding crystals into a condition of break-up one must stop to think what is meant by it.

The statement may account in a particularly happy manner for what takes place, but the average reader after he has pondered over it, will probably consider himself to be much in the same position as the little colored boy who asked the minister where the water in the ocean goes when the tide is out. "Huh! where does it go? Dat am a question what can only be answered in latin. Humpy dumpy dixum doxum soxdologus. That's where the water goes, but, huh! chile you kain't understan Latin!"

Then follows the information: "These crystals are not, of course, mechanically bound together but are related to one another by the laws of molecular formation." If the usual method of making lead battery plates is to bind crystals together mechanically and irregularly the fact is not generally well known. It seems, however, that the manufacturer of the type of battery here described does not place absolute confidence in the "laws of molecular formation" which the committee says are acting so harmoniously to keep the active material of his battery in position. He prefers to put his trust in a good solid piece of asbestos; this perhaps is not to be wondered at. As a rule the man who has charge of the actual construction of a lead battery has but a limited knowledge of the "laws of molecular formation," he may not feel sure that the laws which regulate the conduct of a molecule are fully understood; he can not therefore know how long the "laws governing molecular formation" can be relied upon to exert themselves exclusively in the interest of any one company. He may think that they are liable at any time to start to work to pull together the crumbling sulphates and oxides in a rival manufacturers battery, or perhaps devote some of their time to the preservation of the metallic grid.

Scientists need not laugh at the manufacturer for taking what they can clearly see is the quite unnecessary precaution of using asbestos. As by far the most serious weakness in lead batteries is due to oxidation of the grid or support, it is to be regretted that this committee on science has not expressed its opinion on the subject. If the Committee had only been able to explain that the disintegration of the grid is due to "a crowding of the crystals into a condition of break-up" it would no doubt be a valuable contribution to our knowledge of storage batteries and perhaps furnish a clue to those who are trying to discover something that will "accomplish an anti-disintegrating function" for the grid.

With regard to the use of the asbestos the report says: "It

might be thought that the introduction of this asbestos would considerably increase the internal resistance of the cell, but the fact is otherwise." After reading this sentence it might be thought that the introduction of the asbestos would considerably decrease the internal resistance of the cell, but the fact is otherwise. If the reader of the report has patience he will find it stated further on that the "exceptionally good" contact between the chloride pastilles and the grid "compensates" for the resistance of the asbestos and that the resistance of the battery is "not appreciably" higher than that of other types of battery. By the way, why should a committee on science call a pastille which has no chloride in it a chloride pastille? Did the committee make any measurements of the resistance between the grid and the pastilles and also of the resistance of the asbestos? If so it might be of some interest to know the result in figures and also the method of making the tests. If, as the report seems to show, no such measurements were made, it is of the utmost importance to science that this Committee of the Franklin Institute make known the process by which, leaving out of consideration the resistances in the other parts of the cell, it has been able to arrive at the conclusion that the "exceptionally good" contact of the pastilles with the grid "compensates" for what we suppose must be the exceptionally bad resistance of the asbestos. Perhaps clairvoyance may have something to do with the process.

The mere statement that a certain type of lead plate has a "maximum capacity for a given weight" and that the battery can stand "very heavy" discharges without "mechanical violence" is not of quite so much scientific value as the information that the manufacturer is protected by a large number of United States and foreign patents, that the battery is used in Paris, and that it has been reported to the Committee of the Franklin Institute that a plant recently installed in a life insurance building is giving "thus far entire satisfaction." One is rather disappointed on coming to the end of the report to find that price lists and trade discounts are omitted. Enough is said, however, to show how, at times, the high priests of science whose devotion to research does not allow their minds to look at things from a business standpoint can be induced to let their names be used for the purpose of advertising an article whose commercial value can only be determined from practical application, and entirely and absolutely independent of theories involving speculations regarding the ultimate properties of matter.

BALTIMORE, Md.

ANSWER TO MR. BRACKEN'S CRITICISM ON "CHIPS FROM A STORAGE BATTERY WORKSHOP."

Mr. Bracken has in rather a hasty and perhaps sarcastic manner taken upon himself to criticise some conclusions that I have drawn from the facts that come before me in the repair shop of my company, and some warnings that I have given storage battery manufacturers and inventors, in an article of mine published in THE ELECTRICAL ENGINEER of October 3rd, called "Chips from a Storage Battery Work Shop."

I mentioned no names of manufacturers of storage batteries in my list of broken down electrodes, but Mr. Bracken seems to have found that the coat fits somewhere too snugly for his comfort.

However, the conclusion arrived at by facts constantly brought before me in the repair shop, as described in my article referred to and criticised by Mr. Bracken, were:—That cast lead is a far less durable support for the active material in the electrodes of a storage battery, than rolled lead, because cast lead was in a more crystallized form than rolled lead, and any amount of pressure brought upon it while cooling from its molten state did not alter the form of those crystals, but merely made them more compact. I also stated that cast lead would not bear the process of electrochemical decomposition at all, as the particles composing the cast lead grids was acted upon too rapidly and the checking of "rotting," as Mr. Bracken calls it, was almost impossible. The very point which made the process employed by the Pumpelly-Sorley Storage Battery Company commercial, is that they can stop the process of decomposition at any point and prevent it from continuing to disintegrate or decompose afterward in the constant charging and discharging on daily battery work, unless an abnormal amount of heat is generated in the charging of the batteries; then the decomposition might be set up again, just as it would in any form of pasted battery under such a charge. Mr. Bracken proves these points for me by citing the Griscom process, patented and tried some years ago. He says the plates in a short time all rotted away and that the process of electro chemical decomposition of lead for forming the electrodes of a storage battery was given up. If Mr. Bracken has studied the directions given by Griscom in his patent, as to the making of his plate, he would have noted that Griscom describes a process of casting his plate in the form of a grid under heavy pressure. The non-success of this form of plate establishes my point, that cast lead in any form will not remain in a firm and practical condition for use or durability, after passing through electro chemical action in the presence of strong acids.

All this I had experimented in before making my rolled lead

plate in which the action of the saws left all the supporting rim of lead in the plate integral, and the entire plate without a joint, but still in the most favorable condition to last, after going through our electro chemical process. Inasmuch as these plates made of rolled lead have been in constant use for 18 months and show not the least disintegration or "rotting" away, the conclusion up to this date is a reasonable one that the rolled lead is better than the cast lead, although cast under powerful pressure like the Griscom plate. Hence Mr. Bracken's argument must be weak.

CHICAGO, ILL.

J. K. PUMPELLY.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS

ISSUED OCTOBER 16 and 23, 1894.

October 16.

Alarms and Signals:—

Apparatus for Signaling the Approach of Street Cars, G. B. St. John, Kalamazoo, Mich., 537,461. Filed Nov. 27, 1893.

An apparatus for signaling the approach of a car to residences along the route.

Treadle for Use in Railway Signaling, J. G. Dixon, Birkby, Eng., 538,481. Filed Feb. 20, 1894.

A contact maker for use in connection with electric block systems on steam railways.

Light Indicator, L. F. Johnson, Poughkeepsie, N. Y., 537,608. Filed Apl. 7, 1894.

Provides means whereby the condition of a railway switch or signal lamp may be reliably indicated at the signal tower.

Conductors, Conduits and Insulators:—

Electric Cable, T. J. Dewees, Palmyra, N. Y., 537,414. Filed July 30, 1894.

Employs an irregular enclosing fibrous covering forming air spaces about the cable and an outer metallic tubing covering the whole.

Weather Protecting Covering for Electrical Conductors, E. J. Houston, Philadelphia, Pa., 537,556. Filed Nov. 17, 1891.

Claim 1 follows:—

As an improvement in electrical conductors, the combination of a contact wire with a thin, pliable, continuous, adhesive, permanent, weather-protecting coating of carbon.

Underground Conduit, J. E. Edwards, Toronto, Ohio, 537,507. Filed June 7, 1894.

A conduit having interior racks for supporting the wires, both racks and pipe sections being provided with openings for the purpose of making connection with the wires.

Dynamos and Motors:—

Dynamo Electric Machine, E. Fawcett, Alliance, Ohio, 537,415. Filed Feb. 15, 1894.

Claim 1 follows:—

The combination, in a dynamo or other electrical machine, of a field piece having a tapering end and a pole piece having a tapering opening to receive the tapering end of the field piece.

Galvanic and Thermo-Electric Batteries:—

Primary Battery and Portable Electric Lamp, S. W. Maquay, London, Eng., 527,436. Filed Jan. 4, 1891.

Lamps and Apparatuses:—

Electric Arc Lamp, A. H. Moses, Jr., St. Louis, Mo., 537,559. Filed Jan. 21, 1893.

An arc lamp of the class in which the carbons are enclosed in a substantially air tight case.

Miscellaneous:—

Electric Clock, C. Gullberg, Jersey City, N. J., 537,523. Filed Sept. 16, 1893.

Railways and Appliances:—

Trolley, W. H. Bache, Bound Brook, N. J., 537,546. Filed Oct. 31, 1893.

Employs a socketed support with an internal groove and a divided bracket having a divided pintle, each section of which is provided with a lug extending into the groove.

Conduit Electric Railway, O. B. Finn, Philadelphia, Pa., 537,601. Filed March 16, 1894.

Consists of an electric railway formed of a shoe connected with the car, a movable stem engaged by the shoe, an arm with which the stem makes contact, and a feed wire carrying the arm.

Switches and Out-Outs:—

Multiple Safety Out-Out, J. F. McLaughlin, Philadelphia, Pa., 537,501. Filed Jan. 18, 1890.

Employs a switch adapted to make successive contacts with a number of fusible strips.

Rheostat, A. J. Shaw, Muskegon, Mich., 537,730. Filed Feb. 15, 1894.

Consists of a metal band folded back and forth in two or more groups with insulating blocks between the folds, and binding bands about the groups to hold them in a compact body.

Telegraph:—

Secret Telegraphy, A. D. P. Weaver, Jackson, Miss., 537,518. Filed Dec. 26, 1893.

Telephones and Apparatus:—

Telephone Call Register, W. T. Gentry, Atlanta, Ga., 537,759. Filed Apl. 20, 1894.

A telephone station instrument having a key adapted to operate a tumbler to which is connected a train of registering dials.

October 23.

Accumulators:—

Method of Manufacturing Elements or Plates for Secondary Batteries, H. F. Kirkpatrick-Picard & H. Thame, London, Eng., 537,861. Filed Jan. 10, 1894.

Claim 1 follows:—

A method of manufacture of elements or plates for secondary batteries, consisting of melting separately galena and metallic lead, mixing the same, and pouring the mixture in a molten condition into a heated metallic mold.

Alarms and Signals:—

Electric Signaling System, B. A. Flake, United States Navy, 537,958. Filed May 13, 1892.

A system intended for use on board ship as an engine room telegraph having a circuit on the principle of the Wheatstone bridge.

Auxiliary Signaling System for Railways, M. S. Conly, Chicago, Ill., 538,123. Filed Feb. 6, 1890.

An electric block system for steam railways automatically sounding an alarm in the cab of the engine or setting the air brakes of the train.

Circuit Changer for Electric Signaling Systems, J. F. Hunter & S. H. Lough, Seattle, Wash., 538,127. Filed Sept. 3, 1893.

Adapted to use in connection with district messenger call boxes.

Dynamos and Motors:—

Metal Brush for Dynamos, W. Vom Branca, Thmerterbach, near Westig, Germany, 537,766. Filed July 2, 1894.

Claim:—

Metal brushes for dynamos consisting of a large number of thin threads or wires of copper or copper alloys laid loosely side by side and held together by a metal wire-cloth.

Electric Motor or Dynamo, C. F. Daniels, Macon, Ga., 537,776. Filed Dec. 2, 1891.

Consists of a number of independent field magnets each made up of two parts, one forming the positive and the other the negative pole, the positive pole of one magnet adjoining the negative pole of the next.

Alternating Current Motor, O. T. Child, Ashland, Va., 538,131. Filed Dec. 23, 1893.

A motor in which the secondary coils are in close relation with one or more masses of iron between the poles of the field magnet.

Lamps and Apparatuses:—

Carbon for Electric Lights, E. G. Acheson, Monongahela City, Pa., 537,836. Filed Aug. 20, 1894.

Claim 1 follows:—

An illuminating body for electric lamps, comprising carbon associated with carbide of silicon.

Carbon Holder for Arc Lamp, E. Lavens, Brooklyn, N. Y., 537,864. Filed Feb. 17, 1894.

Electric Arc Lamp, H. O. Swoboda, New York, 537,901. Filed Feb. 2, 1894.

Relates especially to the magnetic feeding mechanism.

Combined Regulating Incandescent Lamp and Socket, O. A. Hussey, New York, 537,969. Filed May 14, 1894.

Employs two or more filaments and contact pieces so arranged as to register with corresponding pieces in the socket.

Electric Lighting System, G. J. & G. J. T. J. Parfitt, Keynsham, Eng., 538,021. Filed July 12, 1892.

Provides means for cutting out a lamp that has failed in a series system and automatically inserting the corresponding resistance.

Electric Arc Lamp, S. Bergmann, New York, 538,119. Filed Apr. 6, 1894.

Relates especially to the magnetic feeding mechanism.

Metal Working:—

Process of Reducing Aluminum, L. Waldo, Bridgeport, Conn., & F. A. Gooch, New Haven, Conn., 537,846. Filed Sept. 1, 1893.

The process consists in passing a current through a fused bath containing a halogen compound of aluminum, thus electrolyzing and introducing hydrogen into the bath.

Process of Reducing Aluminum, F. A. Gooch, New Haven, Conn., & L. Waldo, Bridgeport, Conn., 537,847. Filed Apr. 23, 1894.

Similar to No. 537,846.

Process of Reducing Aluminum, F. A. Gooch, New Haven, Conn., & L. Waldo, Bridgeport, Conn., 537,848. Filed Sept. 6, 1893.

Similar to No. 537,846.

Process of Reducing Aluminum, F. A. Gooch, New Haven, Conn., and L. Waldo, Bridgeport, Conn., 537,849. Filed Dec. 26, 1893.

Similar to No. 537,846.

Process of Reducing Aluminum, F. A. Gooch, New Haven, Conn., and L. Waldo, Bridgeport, Conn., 537,850. Filed June 20, 1894.

Similar to No. 537,846.

Process of Reducing Aluminum, F. A. Gooch, New Haven, Conn., and L. Waldo, Bridgeport, Conn., 537,851. Filed July 2, 1894.

Similar to No. 537,846.

Extracting Gold from its Ores, L. Palatan, Paris, France, and F. Clerici, Milan, Italy, 538,023. Filed July 18, 1894.

Magnetic Separator, W. H. Williams, Newark, N. J., 538,054. Filed Jan. 29, 1892.

Magnetic Separating Machine, W. H. Williams, Newark, N. J., 538,053. Filed June 27, 1891.

Magnetic Separator, W. H. Williams, Newark, N. J., 538,055. Filed Jan. 29, 1892.

Miscellaneous:—

Self Winding Electric Clock, E. G. Hammer, Brooklyn, N. Y., 538,786. Filed July 18, 1893.

Machine for Black-Leading Electrotypes Matrices, O. B. Beach, Stony Creek, Conn., 537,837. Filed Aug. 23, 1893.

Electric Belt, J. Backstrom & F. W. Johnson, Stromsburg, Neb., 537,932. Filed April 17, 1894.

Cathode for Electrolytic Processes and Method of Making Same, E. Stouls, Paris, France, 538,042. Filed Jan. 12, 1894.

Consists of a core having a covering of plumbago and milk.

Railways and Appliances:—

Rail Bond, W. A. Grauten, Hartford, Conn., 537,735. Filed June 7, 1894.

Employs a turned shank passing through a hole in the rail and being provided with grooves to support the bond wires and ears adapted to fold over and hold them in position.

Support for Trolley Wires, F. C. Flak, Buffalo, N. Y., 537,840. Filed March 1, 1894.

Consists of twin parts riveted together and having in their inner faces inclined grooves forming a passage entirely through their length, and a sleeve adapted to surround and carry the line wire and provided with wings adapted to engage with the inclined passage.

Transformer System for Electric Railways, M. Hutin & M. Leblanc, Paris, France, 537,857. Filed Nov. 16, 1892.

Employs an insulated conductor laid parallel with the track and carrying an alternating current, and a car carrying a secondary coil and a condenser, the convolutions of the former having their planes parallel with the conductor.

Closed Conduit Electric Railway, J. F. McLaughlin, Philadelphia, Pa., 537,874. Filed May 24, 1894.

Claim 1 follows:—

In an electric railway, electro magnets hung from a motor car and pivoted to tilt in the direction of the line of travel and also at right angles thereto.

Closed Conduit Electric Railway, J. F. McLaughlin, Philadelphia, Pa., 537,873. Filed April 5, 1894.

Employs a closed conduit containing a conductor and an exposed sectional conductor whose sections are brought into electrical connection with the main conductor by a magnetic contact upon the car.

Trolley Wire Support, M. M. Wood, Chicago, Ill., 537,920. Filed April 30, 1894.

Employs a bracket arm in which a flexible span wire is adjustably suspended.

Electric Motor for Railway Cars, N. C. Bassett, Lynn, Mass., 537,927. Filed June 23, 1893.

Relates to the method of supporting the motor upon the car axle.

Method of and Means for Controlling Electric Cars, H. F. Davis, Pittsburgh, Pa., 537,947. Filed March 29, 1894.

The method consists in connecting the motors in series and then in parallel with resistances, and diminishing the resistances successively.

Trolley Switch Plate, G. A. Huben, Springfield, Ohio, 538,101. Filed Feb. 23, 1894.

Switches and Out-Outs:—

Electric Switch, J. F. McLaughlin, Philadelphia, Pa., 538,014. Filed May 6, 1893.

A quick acting rotary snap switch.

Telephones and Apparatus:—

Annunciator Signal, I. H. Farnham, Wellesley, Mass., 537,890. Filed Feb. 23, 1894.

Has for its object to enable such annunciators as have given their call signal to notify the operator of the fact if they are not answered promptly.

Telephone Circuit and Signal, T. Spencer, Cambridge, Mass., 538,040. Filed Nov. 18, 1893.

Employs two conductors with a link connection, a source of current in a bridge between them, an induction coil whose two windings are interposed in one of the conductors on different sides of the bridge junction, and a visual signal in shunt around one of the induction coil helices.

Combined Telephonic and Signaling System, H. A. Chase, Boston, Mass., 538,075. Filed June 23, 1894.

Employs a carbon transmitter connected in a branch circuit around the telegraphic transmitter and means for placing the former in speaking connection with a telephonic apparatus at a distant station.

RECOGNIZING RAILROAD EFFICIENCY AND COURTESIES.

A GREAT part of the pleasure attending the trip from the Northern and Eastern portion of the country to Atlanta, for the convention of the American Street Railway Association, was due to the zeal shown by the various railroads in providing for the comfort of their patrons. As a result, the travelers on the two special trains seized the opportunity of the return journey to present resolutions of praise to the respective passenger agents. The Southern Railway special, of the Norfolk & Western, was quite successful, but the honors rested easily with Mr. Leroy J. Ellis, who in spite of many difficulties gave his guests the best service that could possibly be imagined. His large special party not only had a delightful trip going but on their return were enabled to spend several hours at Chattanooga, Lookout Mountain, Natural Bridge and the Luray Caves. The following resolutions were presented:

NATURAL BRIDGE, VA., Oct. 21, 1894.

WHEREAS, a large number of those attending the Atlanta Convention of the American Street Railway Association have travelled to and from that city over the Shenandoah Route, and

WHEREAS, the unqualified pleasure and the brilliant success of the railway trip have been due to the unwearied efforts and thoughtful supervision of Mr. Leroy J. Ellis, Eastern Passenger Agent of the Norfolk & Western Railway, be it therefore

RESOLVED, that the hearty thanks of the passengers by the special train personally conducted by Mr. Ellis, be and are hereby extended to that gentleman for his unremitting attention to their comfort and his prompt acquiescence in any suggestion that could be met.

RESOLVED, further, that Mr. Ellis be and is hereby congratulated upon the striking punctuality in the adherence to the train schedule, as evidencing the high standard of railroad efficiency in the New South, and

RESOLVED, that a copy of these resolutions be engrossed and presented by a Committee to Mr. Ellis, together with a souvenir that may serve to remind him of the occasion as well as of the high esteem in which the street railway men and street railway supply men hold a typical steam railroad man.

The committee of presentation was E. Peckham, W. J. Richardson, J. R. Beteem, J. H. McGraw, W. S. Silver and H. O. Evans, with Mr. Peckham as chairman and T. C. Martin as secretary. The gift selected for Mr. Ellis, who very modestly disclaimed any great share in the success, is a solid silver pitcher, which will grace a silver salver already given him by some other fortunate travelers once in his care.

OBITUARY.

J. B. MCGIFFERT.

James B. McGiffert of the Suburban Electric Light Company of Union County, N. J., died on October 21, at the Elizabeth Hospital, after an illness of four weeks from typhoid fever. Mr. McGiffert was a native of Hudson N. Y. He was graduated from Hamilton College, taught school as a principal in Northern New York, and afterward became a chemist in Hudson. He took a deep interest in electricity, and was made superintendent of the electric works in Hudson eight years ago. He went to Elizabeth in 1890 and organized the Suburban Electric Light Company. It bought out the electric plant there and built a new one that supplies all the towns on the line of the Jersey Central as far as Plainfield with electric light. Mr. McGiffert was also one of the incorporators, the secretary and a heavy stock-holder in the Suburban Electric Railway Company, that intends operating an electric road from Plainfield to Elizabeth. He was thirty-seven years old, and leaves a wife and two children. The interment will take place at Hudson, N. Y.

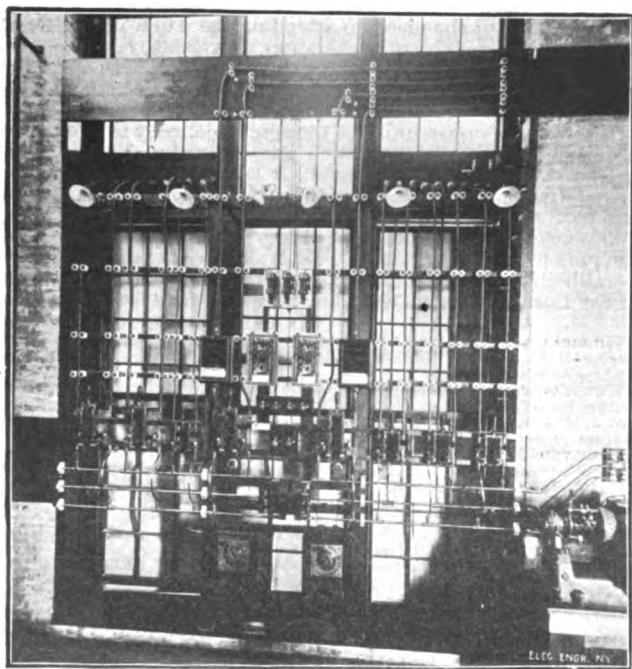
MR. F. A. KIRBY, who was at one time associated with Prof. Morse, died last week at Sayville, L. I. at the age of 79. He was an Englishman by birth.

STARTING OF THE WATERVLIET ARSENAL ELECTRIC PLANT.

The electric light and power plant at the Watervliet Arsenal, for which the E. G. Bernard Co., of Troy, N. Y., were contractors was started at its regular work, on Thursday, Oct. 18th, the injunction having been removed by Judge Coxe.

The installation comprises two complete plants, situated about a quarter of a mile apart, and connected in such a manner that either can furnish the required current to operate the lighting or power circuits in the grounds, shops or other buildings. Plant No. 1 is situated in the engine room of the new gun shop, and consists of two 100 K. W. generators, equal to 185 H. P. each. Plant No. 2 is located in the lower or old shop, and consists of two 50 K. W. generators, equal to about 87 H. P. each. Attached to each plant is a motor generator, used as an equalizer, which permits of the use of any generator whether for the 110 volt or 220 volt circuits. The 110 volt current is used for illuminating purposes and the 220 volt for power.

Fifty-three arc lights are situated in different parts of the grounds. The gun shop is lighted with over 800 lamps, the smaller shops having over 800 lights, while the officers' quarters are illuminated with about 350 lamps. The soldiers' quarters, barracks and offices are supplied with 200 lamps, while scattered about the grounds are 100 more. Power is furnished to run the 75-ton, 80-ton and 150-ton cranes in the new gun shop, which cranes have



BERNARD SWITCHBOARD AT THE WATERVLIET ARSENAL.

from one to four motors each. The system is so arranged that all available water power can be used for lighting and furnishing power as well. The system is so arranged that current for lighting the quarters, or to be used in any part of the grounds for any purpose, can be furnished by water power exclusively, which means a large saving to the government, as the water is not utilized in any other manner, more especially at night.

Mr. Bernard, of the E. G. Bernard Company, designed two new switchboards for this plant, one of which is shown in the accompanying engraving, which allow every wire and connection to be in sight of the person operating the same, giving every possible combination of connections on the several circuits, and insuring against any possible breakage. He also designed and laid out the whole special system of wiring, etc. The entire system is valued at \$30,000.

PERSONAL.

MR. LOUIS C. MOUQUIN, son of the famous restaurateur of Fulton Street, gave a dinner to his friends last week, to celebrate his farewell to bachelorhood, at the Mouquin Restaurant, so familiar to electrical men. Probably a choicer dinner was never served in New York city. Many of his electrical friends were there, including: Capt. W. L. Candee, Durant Cheever, C. W. Price, E. E. Bartlett, Louis Orr, T. C. Martin, Theo. Von der Luhe, and others.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE FRANKLIN INSTITUTE REPORT ON THE CHLORIDE ACCUMULATOR.

THE October number of the *Journal of the Franklin Institute* contains the report of the Committee on Science and the Arts on the Chloride Accumulator, invented by Clement Payen. We give below an abstract of the Report.

"The sub-committee appointed to conduct this investigation has had this battery under careful consideration for a number of months, and has investigated the several features which are claimed to give it merit. During the larger portion of the time a number of cells have been in possession of the committee, and have been placed upon a regular working circuit under the control of one of the committee's members, where they have been subjected to exactly the same usage as a number of other storage cells of other makers and of the same size, so that opportunity was thus given to obtain the results of the performance of the chloride storage battery in regular use, which is ultimately the final test by which the utility of all inventions and improvements must be measured.

"The results of this examination have led to the opinion that this battery embodies certain features of construction which prove it, both theoretically and as verified by use, to be a distinct improvement over hitherto known forms of storage batteries. In order to fully appreciate these features of improvement, it will be necessary to recapitulate, briefly, a few well-known facts regarding storage batteries in general."

The report then calls attention to the difficulties heretofore experienced with storage batteries and especially to the disintegration which occurs and on this point says:

"In the Chloride battery, it is claimed and the committee's investigations go to confirm the correctness of the claim, that the method of construction is such that this disintegration is far less liable to occur."

After describing the method of manufacture of the Chloride cell which is familiar to our readers the Report continues:

"If a section of the spongy lead thus made, be examined, it is found that the metal is in a crystalline condition, and that the crystals are all uniformly arranged with their longer axes perpendicular to the surface of the plate. This provides interstices, so that the changes of volume occurring in the chemical reactions of electrolysis, may take place without exerting lateral pressure upon the crystals, or otherwise crowding them into a condition of break-up. These crystals are not, of course, mechanically and irregularly bound together, but are related to one another according to the laws of molecular formation, and are, consequently, much more strongly bound together than if they had been mechanically combined.

"Furthermore, this crystalline structure presents the maximum obtainable surface for the given mass, an infinite number of inter-crystalline channels passing all through the material and the entire plate being of the same thoroughly spongy consistency, except in those small portions where the continuous lead framing is encountered.

"The effect of this extreme porosity and surface area is to give the battery a maximum capacity for a given weight and size of cell, an item of great importance when considered with reference to the demands of traction. Very heavy discharges also can be taken from this battery, owing to the interstices between the crystals permitting changes of volume to occur without mechanical violence to the structure.

"It might be thought that the introduction of asbestos would considerably increase the internal resistance of the cell, but the fact is otherwise, the resistance of the cell being not appreciably higher than that of other lead cells. This is undoubtedly due to the fact that the larger part of the resistance of most lead cells is that caused by poor contact between the lead framing and the paste placed in it. In the chloride battery this contact is exceptionally good, owing to the pastilles of chloride being so firmly bound by the framing cast under pressure as to compensate for any resistance due to the asbestos.

"Believing that this battery is a noteworthy and meritorious improvement upon many other forms of lead battery, tending to greater durability, greater capacity without increase of weight, and making possible heavier discharges without injury, the Institute, therefore, recommends the award of the John Scott Legacy Premium and Medal to Clement Payen, the inventor."

OHIO STORAGE BATTERY CO.

WE are informed, that the Ohio Storage Battery Company, which has been recently organized, will henceforth manufacture and sell the well known Ford-Washburn storage cells, under a sole license. These cells have been employed in stationary and railway work with excellent results.

DOUBLE DISCHARGE JAMES LEFFEL TURBINE.

The accompanying illustration represents a unique and effective design of a new type of turbine wheel on a horizontal shaft built by James Leffel & Co., Springfield, Ohio. It is simple in form, and capable of easy and very substantial construction. The engraving is an exact reproduction from a photograph of a wheel in actual use, driving a portion of a large electric plant where several others of the same design and style are in use, under a working head pressure of 90 feet.

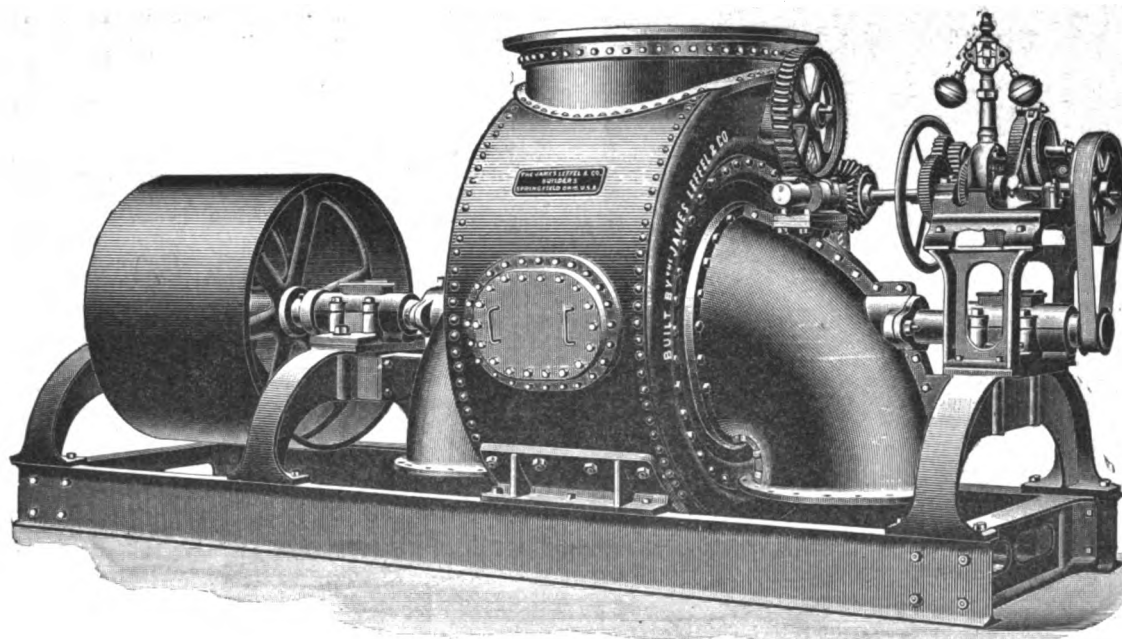
It will be seen that the water enters vertically at the top. The design, however, admits of receiving the water at any inclination from a vertical to a horizontal line. When it enters this outward casing, in which is placed the guide casing of the wheel or runner the water completely surrounds the guide casing, under whatever head pressure the wheel is placed, and is admitted to the circumference of the runner or wheel proper through the guides, leaving the wheel after doing its work. The runner itself is a double wheel, receiving the water from a single set of guides, which surround its circumference. The wheel is so constructed as to divide the water into two equal portions on receiving it from the guides. The water then passes through the curved tubes on each side of the wheel and discharging into the tail water below. This method of application of water to a turbine avoids end thrust and prevents the water from getting between the wheel

lbs. sulphuric acid, commercial, in lots of not less than 2,000 lbs. (this office to furnish carboys), prices to be quoted for delivery f. o. b. at Fort Logan, Col., and f. o. b. at place of manufacture; 50 lbs. wire, office, No. 18; 1,000 zincs, Callaud, No. 1, best spelter, strongly boxed, 20 in a box (as wanted); 50 zincs, Leclanche. Prices for bluestone and Callaud zincs are to be quoted for delivery at this office and f. o. b. place of manufacture. Sample required.

AYLSWORTH & JACKSON.

UNDER the above firm name Messrs. J. W. Aylsworth and F. E. Jackson have formed a partnership for the manufacture of incandescent lamp filaments and other specialties. As they will not manufacture lamps themselves they are thus in a position to supply lamp manufacturers with filaments made to any specification.

Mr. Aylsworth was until recently in the lamp works of the General Electric Co., at Harrison, N. J., as chemist in charge of the carbonizing department, and Mr. Jackson was for several years with the same company in charge of the lamp testing department. The experience of the personnel of the firm is thus a guarantee of the high quality of their product. The factory is located at 129 Essex Ave., Orange, N. J.

**DOUBLE DISCHARGE JAMES LEFFEL TURBINE.**

and any part of the casing, with consequent loss of power. The wheel illustrated is 30 inches in diameter and of 550 horse power capacity. Its regulation is secured automatically, by means of a governor especially adapting it to electric light and power work.

The wheel has a pulley of 42 inches face, 48 inches diameter, transmitting the whole power through a 40 inch belt. Three pairs of a modification of this type of wheel were recently supplied to an electrical plant in Mexico. Each pair was 20 inches in diameter and of 600 horse power. The transmission in this instance was 18 miles.

A LITTLE LIST OF ELECTRICAL SUPPLIES FOR THE U. S. SIGNAL OFFICE.

The War Department, through the Signal Office, is inviting proposals until 2 o'clock, Friday, November 16, 1894, for furnishing the following telegraph and signal supplies for the Signal Service: 75 boxes bluestone, prime W. U. standard, 50 lbs. in each box; 2,700 lbs. bluestone, prime W. U. standard, packed in barrels, 300 lbs. in a barrel; 50 boxes packing, 30" long, 16" wide, 13" deep, with battens $\frac{3}{8}$ " white pine, D. B. S.; 50 boxes packing, 30" long, 16" long, 8" deep, with battens $\frac{3}{8}$ " white pine, D. B. S.; 50 carbons and prisms, mounted for Gonda Leclanche Battery; 50 cells, Leclanche, Gonda prism, complete with sal-ammoniac; 200 connectors, battery, double, smooth finish; 6 hydrometers; 6,000 lbs. iron filings, pure, free from dirt, oil, etc., prices to be quoted for delivery, f. o. b. at Fort Logan, Col., and f. o. b. at place of manufacture; 300 jars, battery, Callaud, No. 1; 25 lbs. mercury, for use in Gethin's battery, in strong jars securely packed; 8,000

THE STILLWELL-BIERCE & SMITH-VAILE COMPANY.

An excellent description of the Portland General Electric Co.'s plant at Oregon City, Oregon, profusely illustrated has been reprinted from the *Street Railway Journal* and issued in pamphlet form by the Stillwell-Bierce & Smith-Vaile Company, of Dayton, Ohio. The entire power equipment of the station was manufactured by this company after designs made by Mr. A. C. Rice the general superintendent and engineer, who also drew the building plans and those for the enlargement of the canal and of the head gates. The pamphlet contains also an illustrated description of the company's works at Dayton and of some of the most important turbines and apparatus there manufactured.

MONTREAL NOTES.

MR. F. W. HARRINGTON, the well-known representative of the New York Insulated Wire Company, was a recent visitor to Montreal, in the interests of his Company.

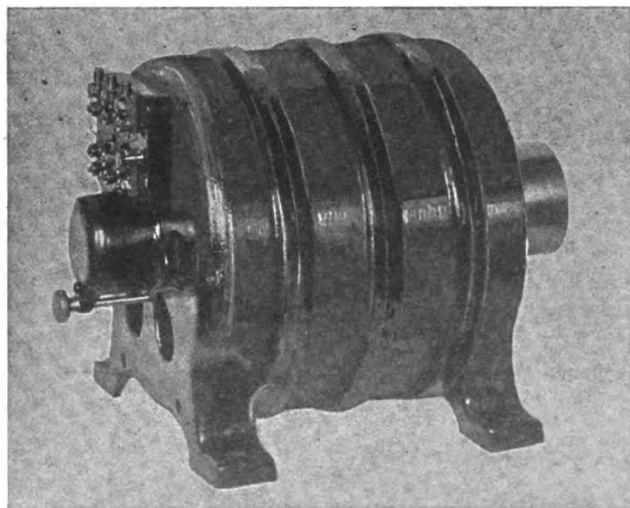
THE DOMINION GOVERNMENT has passed an act legalizing the Units of Electrical Measure adopted by the Chicago Electrical Congress last year.

MR. HENRY F. KELLOGG, general selling agent of the Whitney Electrical Instrument Company, reported when in this city that the Whitney Co. would soon put an entirely new measuring instrument on the market, which it was expected would have an extensive use and meet with as great success as the other Whitney instruments.

G. E. 1 H. P. INDUCTION MOTOR.

A good example of the smaller line of induction motors which the General Electric Company is placing on the market is the 1 H. P. motor shown herewith.

This motor has been designed to give a powerful starting effort without excessive current. It is completely enclosed and may be entirely so, if desired. It is totally without moving contacts and the only connection it has with the external circuit is through the binding posts on the outside of the motor; the armature has no connection with the external circuit. Inside of the armature is



G. E. 1 H. P. INDUCTION MOTOR.

placed a resistance, only thrown in circuit when the motor is first started. The plug shown on the outside of the motor under the bearing short circuits this resistance as soon as the armature has attained its speed. The motor is wound for 110 volts, and owing to the simplicity of the winding and the low potential burnouts are almost impossible. The absence of commutator and collector rings obviates all danger of sparking and entails the minimum amount of attention in operation. As regards efficiency, uniformity of speed and output per pound of weight, this motor is equal to the best continuous current motors of similar output.

STEEL RAILS WANTED.

We have received an inquiry from an electric railway manager for five miles of good second hand 60 pound steel T rail for immediate use in electric railway work.

NEW YORK NOTES.

MR. T. H. FOOTE, of 215 West One Hundred and Twenty-Fifth street, is in the field as a consulting electrical engineer. He was four years with the Edison Machine Works and four with the Waddell-Entz Co. In the latter service he was actively connected with the storage battery car work on the Second Avenue line.

THE INTERIOR CONDUIT AND INSULATION CO., of 44 Broad street, have issued a very handsome new catalogue of their iron armored insulating conduit, "single tube system." This addition to the resources of electric lighting has been most timely, important and welcome and we are glad to note that the company is experiencing an enormous demand. The conduiting of wires is now accepted everywhere as the right thing.

W. R. BRIEY, of "Kerite," is issuing to his friends a handsome little pocket book with calendar for 1894-5. It has two admirable little tables, one of the dimensions, weight, resistances and capacity of copper wire, and the other of the dimensions and resistances of copper wire larger than No. 0000 B. & S. This latter table will fill a longfelt want, especially as one column shows the horse power that can be carried at 500 volts.

THE OAKMAN ELECTRIC COMPANY, of 186 Liberty street, is doing a good business in dynamos and motors, making a specialty of Wenstrom apparatus. The company consists of Messrs. Henry B. Oakman and Harry M. Shaw. The factory at Bridgeport, Conn., turns out all sorts of electrical supplies from insulating tape to central station and railway power plants complete.

MR. MAXWELL M. MAYER, until recently electrical engineer of the Zucker & Levett Chemical Co., has now established his own factory and will build motors and dynamos for all purposes.

While with the above mentioned firm Mr. Mayer built no less than 500 machines, for lighting, power and plating purposes, which have gone to all quarters of the globe, and have given excellent results. The Mayer Works are situated at 107th street and East River, New York.

NEW ENGLAND NOTES.

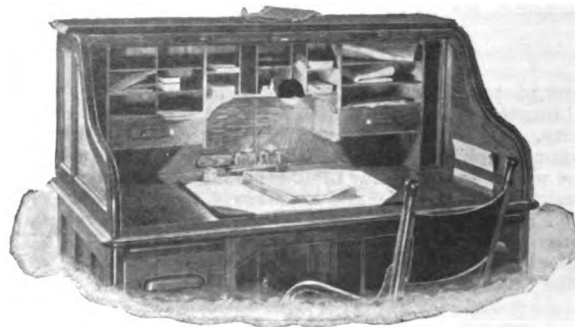
ANCHOR ELECTRIC CO., of Boston, is the name of a new company which has just been formed to succeed to the business of the Brown Electric Co., the supply business of the Hawks Electric Co., and the supply business of the Iona Manufacturing Co., all of Boston. Mr. H. C. Hawks is president of the new company, Mr. Norman Marshall, vice-president, and Mr. Philip M. Reynolds, treasurer, all gentlemen well and favorably known in the electrical business in New England and elsewhere. They have leased a commodious store at 71 Federal street, near the corner of Franklin street, and expect to be ready to do business in their new quarters about the first week in November. The Anchor Electric Co. will do a general electrical supply business, and will carry a full line of goods to meet all demands for prompt shipment.

THE HAWKS ELECTRIC CO., of Boston, will continue their construction business as heretofore, with Mr. W. F. Fowler, as manager, and expect to move shortly into new offices on Franklin street. Mr. H. C. Hawks, who has just become president of the new Anchor Electric Co., notice of whose formation will be found above, will no longer be actively connected with this company, but will devote the whole of his time to the Anchor Company. Mr. Fowler has been associated with Mr. Hawks for years in the construction business, and is a thoroughly competent electrical engineer, and will undoubtedly achieve the same amount of success which this company has enjoyed so long.

THE PETTINGELL-ANDREWS CO. of Boston, have added another valuable agency to their excellent line of specialties. They have just completed arrangements with the Steam Engine Co., of Watertown, N. Y., to represent their well-known type of engine in New England. The Pettingell-Andrews Co., having now the agency of the Lundell dynamos and motors, are gradually working into heavier classes of goods, and they have thought it advantageous to have an engine which they could recommend, and which they would be enabled to quote on estimates for complete plants. They are still, however, paying the same attention to their general supply business, and are now making arrangements to have a better and fuller display of goods for the regular retail business, which their excellent location and large commodious quarters enables them to do.

THE NEW DESK LIGHT.

We illustrate herewith the novelty recently introduced by the Desk Light Co., 201 Penn Mutual Building, Philadelphia. The arrangement is such that, as shown in the cut, an ordinary desk pigeon hole takes care of the lamp when not in use, and it is lighted by simply withdrawing it from the pigeon hole, current



NEW DESK LIGHT.

being conveyed by means of the guides for the carriage on which the lamp travels. The desk cannot be shut until the lamp has been pushed back into its pigeon hole, and the act of returning it breaks the circuit and so puts the light out. The lamp is very advantageously placed for throwing its light downward and distributively on the desk just where it is needed, and not upward where it would be wasted. This specialty has much to recommend it and should find a large use.

Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE Electrical Engineer.

Vol. XVIII

NOVEMBER 7, 1894.

No. 340.

MCGILL UNIVERSITY ELECTRICAL ENGINEERING LABORATORY.

THE electrical engineering laboratories of McGill University, at Montreal, Canada, are the outcome of a careful study of the best electrical laboratories on this continent and abroad and are well arranged for class work and for special investigation. Their equipment is very fine and complete and includes many interesting and novel appliances.

The accompanying engraving shows a portion of the

to meet the requirements of Prof. Carus-Wilson, the Professor of Electrical Engineering, and is well adapted for experimental purposes. It is self-exciting and has an output of 12.5 kw. at 1,000 volts and a speed of 1,500 revolutions a minute. The armature is stationary and is provided with eight coils, two of which can be removed from the armature, and four of the remaining six are movable in arcs around the armature. When the two coils are removed, the remaining six are connected in pairs which can be moved into positions at any angle with respect to each other. In this way, two or three currents can be

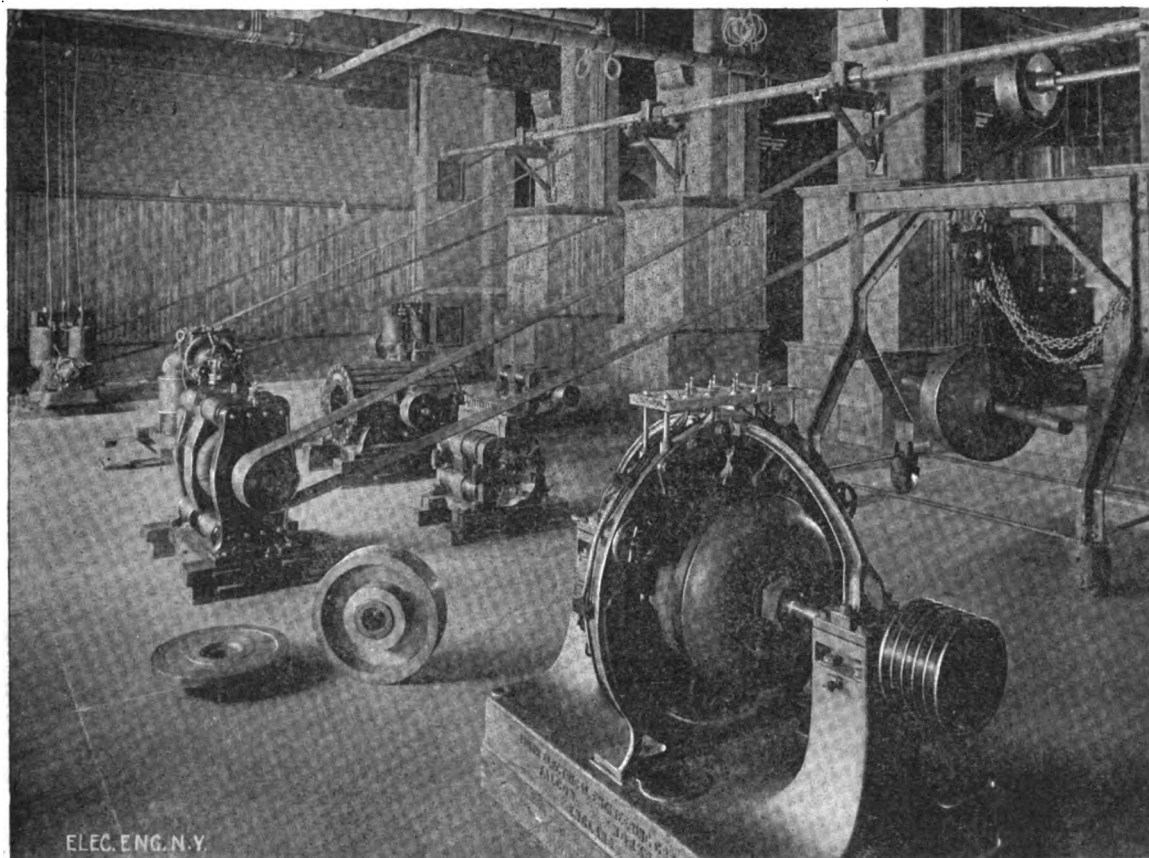


FIG. 1.—MCGILL UNIVERSITY ELECTRICAL ENGINEERING LABORATORY—DYNAMO ROOM.

dynamo room and some of the experimental dynamos which comprise: two 12 kw. Edison dynamos, a 7 kw. Victoria-Brush dynamo, a 15 kw. Thomson incandescent dynamo, a Mordey alternator, and Thomson-Houston, Wood and Brush arc dynamos, besides a Victoria-Brush motor-generator, a 5 h. p. Crocker-Wheeler motor and several smaller motors of various types. A number of motors are also in use in the building for driving lathes, fans and light machinery, in addition to a 10 h. p. motor for running an elevator.

The Mordey alternator, shown in the foreground of the engraving, Fig. 1, was specially made for the University

obtained from the coils for experiments with two or three-phase currents.

The main shaft in the dynamo room is driven by a 90 h. p. McIntosh and Seymour engine or by a 25 kw. Edison motor as is most convenient. The shaft is provided with ten magnetic clutch pulleys, designed by Professor Carus-Wilson, to which the dynamos are belted. The pulleys are of two different sizes, capable of transmitting 20 h. p. and 90 h. p. at 350 revolutions per minute and at an expenditure of about 50 watts each. The construction of the pulleys is shown by the small one represented on the floor in the engraving, which is of the 20 h. p. size. The ener-

gizing coils fit in circular grooves in the pulleys and are connected electrically with switches on the walls, by means of rings and brushes. When a coil is connected by its switch with the lighting circuit, the pulley is converted into a magnet and attracts its armature. As the pulleys are loose on the shaft and the armatures are fixed thereto, the magnetic attraction between them causes the pulleys to rotate with the shaft. The pulleys are fitted with "Metal-line" bearings and require no oil. They work very satisfactorily and have proved to be a great convenience.

A convenient arrangement of apparatus for the measurement of alternating current power, was exhibited at McGill to the members of the Canadian Electrical Association during their recent convention at Montreal, and was illustrated by an actual test of a transformer.

This arrangement, which excited much interest, is due to Professor Carus-Wilson who, in describing it, pointed out that of all the methods of measuring alternating current power, of which a good account might be found in Professor Fleming's "Alternate Current Transformer," pp. 541-536, and in the same author's excellent paper published in the *Proceedings* of the Institution of Electrical Engineers of London, (No. 101,) the wattmeter method had gained by far the greatest favor amongst those who had occasion to make frequent and rapid tests in the workshop or factory.

The apparatus was arranged as follows: A Kelvin

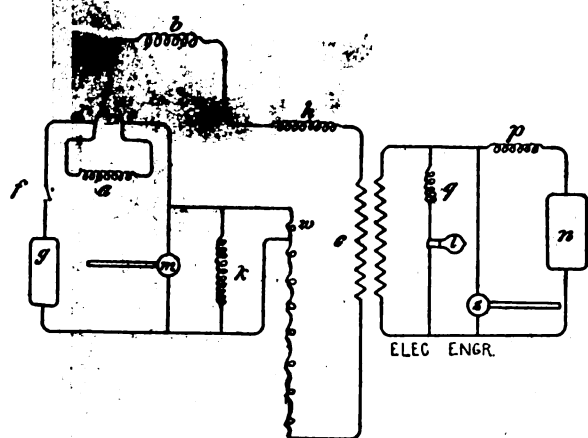


FIG. 2.—PROF. CARUS-WILSON'S METHOD OF MEASURING ALTERNATING CURRENT POWER.

composite balance carried the primary current through its fine wire swinging coil *a*, Fig. 2 and its fine wire fixed coil *b*, to the primary of the transformer *c*, when the switch under the instrument was connected to *d*. If, however, the switch be connected to *e*, and the terminal *d* connected through a switch *f*, and a non-inductive resistance *g*, to the main, the fixed coils then carry the primary current and the swinging coils are connected as a shunt, so that the instrument will now be in condition to read watts. All that is then necessary is to know the reading of the instrument as an ammeter and the resistance of the shunt. When the switch is placed to *d*, the primary current is read off, and immediately afterwards the switch is turned to *e*, and the primary watts obtained. This simple arrangement appears to be a valuable addition to the instrument as generally used, as with the lightest weight, 12.5 watts gave a range over the whole length of the scale, while with the ordinary attachment and the same resistance (200 ohms) in the shunt circuit, 12.5 watts only give a range of one division of the movable scale. Since the watts in the primary of a transformer on open secondary, may be as low as 60 or 70, it is of importance to have a wattmeter with the wide range at low values obtained by this arrangement. The difference between this arrangement and the usual one is that the fine fixed coil of the balance is used to carry the primary current instead of the thick fixed coil and,

further, the connections are so arranged that the current readings can follow the watt readings without any change in the connections.

In the experiment shown, the shunt circuit was connected to one of the eight coils *w*, of the fixed armature of a Mordey alternator which supplied the current, so that the watt values were obtained by multiplying the readings by eight. The primary volts were observed by a Cardew voltmeter *m*, kept in the circuit and arranged so that its reading could at any moment be checked against the Kelvin balance used as a voltmeter. Thus when the primary current had been observed, the apparent watts could be arrived at and hence the power factor and the angle of lag.

A Weston wattmeter was inserted in the primary circuit so that its series coil *h*, was in series with that of the Kelvin balance and its shunt coil *k*, in multiple with that of the balance. A comparison of the relative convenience of the two for this special purpose was made and it was observed that while it took 150 watts to give a full scale deflection on the Weston instrument, 12.5 watts took the lightest weight of the Kelvin balance to the end of a scale about twice the length. The wattmeter shown was understood to be the one of lowest range made by the Weston Company, but it seems probable that there will be a demand for one that will enable open secondary losses to be determined with greater precision.

The power in the secondary circuit of the transformer was taken up in a rheostat *n*, made for McGill University by the Carpenter Enamel Co. In this rheostat which can absorb 5,000 watts, any current from one to fifty amperes, rising by one ampere at a time, can be drawn from a 100 volt circuit. The main current of the secondary passed through the fixed coil *p*, of a Siemens dynamometer, while the swinging coil *q*, was connected as a shunt with a 50 c. p. incandescent lamp *l*, between the two terminals of the secondary. A special arrangement had been made in the dynamometer by which the fixed and swinging coils were quite separated, and, knowing the constant of the instrument as an ammeter and the resistance of the shunt, the watts in the secondary were at once obtainable, and hence the efficiency at different loads. The drop was observed by means of a Cardew voltmeter *s*.

An electrostatic voltmeter is sometimes used in the secondary circuit, as it does not absorb power and avoids possible error in consequence, and one of these instruments was exhibited at the time. The lamp in the shunt circuit is assumed to be without self-induction, but it would be better to have a non-inductive resistance made specially for this purpose, if a permanent testing set were being arranged. The non-inductive resistance in the primary shunt is supplied with the Kelvin instrument and is made with special terminals for multiplying the reading by two or four.

The whole of the apparatus was very compactly arranged on a table set apart for transformer tests in a room immediately over the dynamo room. The wires from the alternator were brought up through the floor, and the primary volts could be held at any required reading by a rheostat in the field circuit, placed close to the table.

In concluding the description of the apparatus, Professor Carus-Wilson said that in his opinion the Kelvin balance was admirably suited for use of this kind, as it could be made to do duty as wattmeter, voltmeter and ammeter, but had the disadvantage that it was not portable and required careful handling. As a portable wattmeter, probably no instrument would surpass the Weston, though its range was not always convenient. The Siemens dynamometer could be converted into a good wattmeter by a slight modification, but it was not portable and required careful setting. It would however be wise in any case to carefully test any wattmeter to ascertain that the shunt circuit is practically free from capacity and self-induction, as otherwise errors may occur.

ELECTRICAL MACHINIST PRACTICE.—VIII.

BY

James F. Hobart,

The "home-made" apparatus described in this paper was designed by a machinist for expediting his daily work. It is used in connection with the devices described in papers VI and VII of this series, and saves a good deal of time and labor, as a single incident will illustrate. In winding field coils for a certain motor, No. 28 wire was used, and the coil was about 9 inches in external diameter, three inches wide, and the winding two inches deep. A simple two-pole motor was used for winding, the core mold being screwed directly to the motor-shaft. It was a full day's work for one man to wind a pair of these field coils, with the conveniences at hand. The motor was controlled by a rheostat, the lever of which was located on the bench, convenient to the left hand. The fine wire (No. 28) used in these coils has a very annoying habit of climbing, or running up on top of the other coils, and when running pretty fast, should a "climb" occur, quite a number of turns of wire will be wound on before the motor can be stopped by means of the rheostat, and the hand pressed on the coil for a brake. As both hands are needed to guide the wire and handle the tension, it can easily be imagined how much time is lost in unwinding "climb" coils, and in reaching from wire to rheostat and back again.

The loss of time and wire finally led to the development of the coil winding apparatus shown by Fig. 31. This machine has attached to it all the conveniences described in papers VI and VII, but for the sake of clearness, the various instruments are shown separately in the papers named (Oct. 24 and 31) and illustrated by Figs. 24 to 30. In Fig. 31, here shown, the treadles *a* and *b* are connected so as to operate the starting and controlling rheostat *d*, and the reversing switch *p*, *l*. The rheostat *d* is connected to the treadle *b* by a peculiar mechanism. The axis upon which the rheostat arm revolves is extended to form a shaft which carries the small pulley *c*, and is journaled in the post which also supports one end

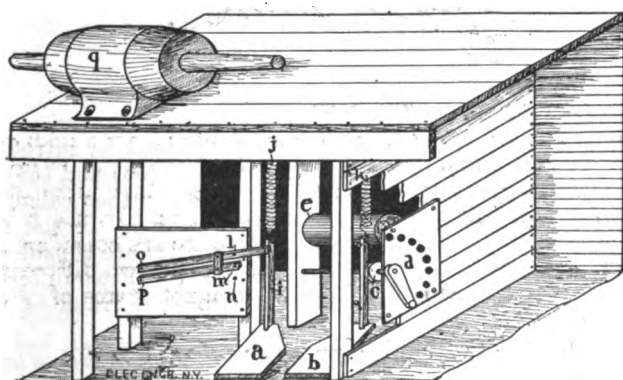


Fig. 31.

of the resistance coil *e*. A standard at the left of *c*, is connected with that pulley by a flexible wire, or stout cord of linen or cat-gut. The cord passes once around the pulley *c*, and is fastened thereto at one point only. The cord is fastened to the upper and lower ends of the standard by wedges on screws, as shown in the engraving. The coiled spring *k*, is stiff enough to hold up the weight of standard of the treadle *b*, and to revolve the rheostat arm back to its zero position when the foot is removed. The spring must be ample for this purpose, as no other way of shutting off the current is furnished. The diameter of the pulley *c* and the lift of the treadle *b* must bear a certain

ratio to each other, which a simple calculation will quickly determine.

The reversing switch *p* *l* is connected up in a similar manner, the standard *i*, and spring *j* connecting the switch with the treadle *a*. The reversing switch is made in the ordinary manner as shown at *a* *b* 2, 3, Fig. 34, except that the contacts *o* *l* and *p* *m* consist of screws let into square wooden strips and connected by pieces of wire. The contacts *l* and *n*, Fig. 31, are connected to one of the commutator brushes, the contact *m*, being connected to the other brush; this causes current to be continuous through the field coils, and reverses it in the armature when running backward. The terminal *o*, is connected with the zero terminal of rheostat, while the terminal *p* goes to the

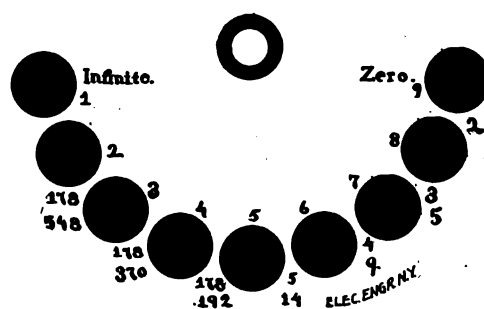


Fig. 32.

negative line wire. A Storey, iron-clad, water tight motor, *q*, entirely enclosed was used with this apparatus. It would run about 3,000 revolutions per minute, on a 110 volt circuit, and consumed about three amperes when fully loaded. The bridge resistance of the motor measured 22 ohms. The rheostat in use with the hand switch was very poor and bridge measurements proved it to be badly out of balance, short-circuited, and non-connected, making it a very possible cause of fires. It was, therefore, decided to make a new rheostat for the "treadle controller," so calculated that the motor could be run very slowly if so desired.

Three amperes being the ordinary current, the resistance necessary to start up without danger of burning would be

$$3 = \frac{110}{22 + R} = 14\frac{1}{2} \text{ ohms.}$$

It was decided to use 7 coils in the new rheostat, disposing of them as shown in Fig. 32. As contact No. 1 has no connection with the others, it is of infinite resistance, and is so marked. Contact No. 9, is likewise disposed of, the rheostat being entirely out of circuit when the arm rests upon this contact. It is therefore marked zero. As $14\frac{1}{2}$ ohms resistance is necessary to keep out an excess of current, that amount of resistance is put in when the switch is on contact 5; hence the figures 5-14, below the space between 5 and 6, meaning 5 ohms resistance between 5 and 6, and 14 ohms total resistance between 5 and 9. By experiment it was found that $\frac{1}{3}$ ampere would just start the motor, and that current was decided upon for contact 2. Hence the resistance neces-

$$\text{sary would be } .2 = \frac{110}{22 + R} \therefore R = 548 \text{ ohms. (Counter m. f. is not considered as the calculations are for the instant of starting.)}$$

Hence there will be $548 - 14 = 534$ ohms to be divided between contacts 2 to 5, or $534 \div 3 = 178$ ohms each, making the several resistances as shown in Fig. 32.

The rheostat was constructed upon a novel plan as illustrated in Fig. 33. It is absolutely fireproof, being made of incombustible material exclusively. The core consists of a brass rod as iron becomes magnetic and causes trouble by its induced magnetism. A sheet of asbestos is wrapped around the rod, and the first coil of 178 ohms resistance is wound on. Bare iron wire was used, being wound far enough apart, on a thread cutting lathe, to prevent the

coils from touching each other. The ends of the first coil were brought out and tagged "1 a and 1 b," as shown in the engraving; then another layer of asbestos paper and another coil of 178 ohms were wound on the ends of this coil were tagged "2 a and 2 b."

The other coils are put on in a similar manner, the coils of greatest resistance being put next the core, because less heating is done in these than in the 2 and 3 ohm coils which are used much more than the higher resistances. The first resistance made in this manner was specially wound to avoid induction. When one layer of wire was completed, and before the asbestos was put on, the wire was tied fast with a piece of adhesive tape, then the asbestos was put on, and the next layer of wire wound on *in a direction opposite to the first coil*. In this way the inductive effects of one layer of wire was made to counteract that of the next coil, and so on through the whole winding. Other coils subsequently made, did not possess this refinement, being wound straight through, and upon old iron bolts, bits of gas pipe, or any other available material. Induction *may* have caused some loss, but it was never observed during the operation of the motor.

Quite small wire was used for the high resistance coils, and about No. 16 wire was put into the low resistances so that if a large current *should* get into them, it would be carried without danger of overheating. The connections are clearly shown by Fig. 34. The positive and negative leads at c, branch through the double pole switch d, then pass through the double fuse e, the positive branch going direct to the rheostat lever at g. The end of the rheostat is shown at h and all the coil terminals are shown with appropriate tags. From the 7b rheostat terminal, the wire runs to both field coil i and reversing switch a. From the latter it goes to one of the commutator brushes, according to the position of the switch. Returning from the armature the current flows through the switch 3 b, thence back to the negative fuse, rejoining the field current just before reaching the fuse. Reversing is done, as stated, by changing the armature current, the field current passing continuously in the same direction. This prevents the necessity of suddenly reversing the polarity of a large mass of iron, all the change that has to be made, being in the armature where changes are constantly being made, as a matter of course.

In winding coils with this apparatus, the thumb, of the left hand can be pressed lightly upon the magnet wire as it passes from the right hand to the coil. The fore finger is placed lightly upon the top of the coil or at the point where the straight wire begins to curve onto the coil. With the hand in this position, the thumb can put just the right

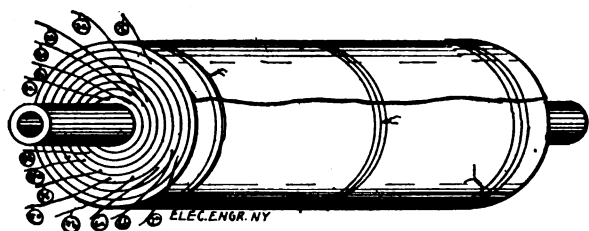


FIG. 33.

pressure upon the wire to make it guide properly. The fore finger being on the coil, it can instantly detect any tendency of the wire to "climb," and if the wire does ride up on top of the coil, the motor may be stopped instantly, preventing any further miswinding.

By reference to Fig. 31, it will be seen that the treadles and their connections are so arranged that the spring j holds the reversing switch always in the "go-ahead" position. The motor is started ahead by pressing down the treadle b, which, by the way, is merely a piece of board inged to the floor by a piece of leather, which is nailed to

both floor and treadle. Pressing treadle b, starts the motor, and pressing treadle a, reverses the direction of rotation. The spiral springs return both treadles to their normal positions as soon as pressure is removed. In winding a coil, the speed is gradually increased, while the wire runs well, but should it climb up, the left foot may be depressed very quickly, reversing the motor, and bringing the armature to a stand still at once. Just as quick as the left foot is depressed, the right foot should be raised,

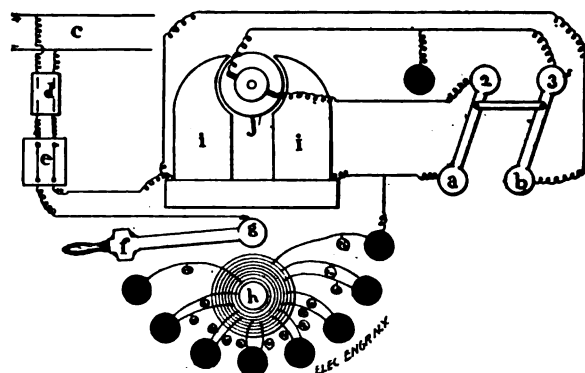


FIG. 34.

cutting off current before the armature has a chance to begin to revolve backward. By skilful manipulation, the motor can be stopped dead in this manner, without running backward a particle and loosening several coils. With the motor revolving at 1,000 revolutions a minute, it is possible to stop it dead, by the method described above, before the surface of the coil has travelled four inches. The coil needs to be strongly screwed to the armature shaft, or one of the "emergency stops" will send it spinning.

MAGNETIC LEAKAGE IN DYNAMO-ELECTRIC MACHINERY.—IX.

(Concluded.)

BY

Alfred E. Whence.

B. Calculation of Total Flux.

The numerical value of at_m being obtained by introducing the values found from formulæ (52), (55) and (66) or (67), respectively, into equation (50), we can then calculate the total magnetic flux through the machine. In the following, the two cases occurring in practice are considered separately, viz. (1) but one material, and (2) two different materials being used in building the magnet frame of the machine.

a. Calculation of Total Flux when Magnet frame consists of but one material.

If but one single material—either cast iron, wrought iron, mits metal or steel—is used in the magnet frame, the calculation of the total magnetic flux is a very simple operation.

For, if l_m denotes the length of the magnetic circuit in the magnet frame, from air gap to air gap, and $\mathcal{B}_m$ is the corresponding mean specific magnetization, then, according to the general formula (51) we have

$$at_m = l_m \times f(\mathcal{B}_m). \dots\dots\dots (68)$$

But the density in the magnet frame, $\mathcal{B}_m$, is the quotient of the total flux per magnetic circuit, Φ , by the mean sectional area, A_m , of one magnetic circuit in the field frame, consequently :

$$at_m = l_m \times f \left(\frac{\Phi''}{A_m} \right),$$

from which follows:

$$f \left(\frac{\Phi''}{A_m} \right) = \frac{at_m}{l_m} = \frac{AT - (at_k + at_s + at_r)}{l_m} \dots (69)$$

Dividing the numerical value of at_m as found by formula (50), by the length, l_m , of the circuit, we therefore obtain the numerical value of the specific M. M. F. per inch length for the respective material. By means of Table III, or Fig. 51, then, the density $\mathcal{B}_m$, corresponding to this particular value of $f(\mathcal{B}_m)$ for the material employed can be found; and since

$$\mathcal{B}_m = \frac{\Phi''}{A_m},$$

we obtain the total magnetic flux per magnetic circuit of the machine from the simple formula

$$\Phi'' = A_m \times \mathcal{B}_m, \dots (70)$$

where A_m = mean sectional area of magnet frame in square inches;

$\mathcal{B}_m$ = density of lines of force in magnet frame, corresponding to the value of $at_m + l_m$ in Table III., or in Fig. 51.

$$= l_w \times f \left(\frac{\Phi''}{A_w} \right) + l_c \times f \left(\frac{\Phi''}{A_c} \right), \dots (71)$$

or, by comparison with formula (50):

$$l_w \times f \left(\frac{\Phi''}{A_w} \right) + l_c \times f \left(\frac{\Phi''}{A_c} \right) = AT - (at_k + at_s + at_r). \quad (72)$$

This equation contains two unknown quantities, viz.:

$f \left(\frac{\Phi''}{A_w} \right)$ and $f \left(\frac{\Phi''}{A_c} \right)$, and can, consequently, not be solved directly. Table III, however, affords the means of calculating Φ'' in an indirect manner as follows:

The useful flux, Φ , being known by virtue of formula (1), or (2), respectively, an assumption can be made of the total flux per circuit, Φ'' , by adding to the useful flux per

circuit, $\frac{\Phi}{z}$, — z being the number of the magnetic circuits

in the machine—, from 10 to 100 per cent. according to the size and the type of the dynamo (see Table V.) In dividing this approximate value of Φ'' by the areas A_w and A_c , respectively, the densities $\mathcal{B}_w$ and $\mathcal{B}_c$ are obtained, and by means of Table III (Fig. 51) the corresponding values of $f(\mathcal{B}_w)$ and $f(\mathcal{B}_c)$, respectively. Introducing these values in the equation,

TABLE V. LEAKAGE FACTORS FOR VARIOUS TYPES AND SIZES OF DYNAMOS.

CAPACITY IN KILO WATTS	FACTOR OF MAGNETIC LEAKAGE, λ															CAPACITY IN KILO WATTS
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
	UPRIGHT HORSESHOE TYPE	INVERTED HORSESHOE TYPE	HORIZONTAL HORSESHOE TYPE	SINGLE MAGNET TYPE	VERTICAL DOUBLE MAGNET TYPE	HORIZONTAL DOUBLE MAGNET TYPE	BIPOLAR IRON CLAD TYPE	VERTICAL DOUBLE HORSESHOE TYPE	HORIZONTAL DOUBLE HORSESHOE TYPE	FOURPOLAR IRON CLAD TYPE	SINGLE MAGNET MULTIPOLAR TYPE	RADIAL MULTIPOLAR TYPE	INNER- POLE TYPE	TANGENTIAL MULTIPOLAR TYPE	AXIAL MULTIPOLAR TYPE	
1	2.00	1.75	.....	1.90	.....	1.50	1.50	.....	.....	.....	.....	.....	.....	.....	.....	1
2.5	1.80	1.60	.....	1.75	2.00	1.40	1.40	.....	.....	.....	.....	.....	.....	.....	.....	2.5
5	1.70	1.50	.....	1.65	1.90	1.35	1.35	1.80	1.90	.....	.....	.....	.....	.....	.....	5
10	1.65	1.45	2.00	1.60	1.80	1.30	1.30	1.70	1.75	.....	.....	.....	.....	.....	.....	10
25	1.60	1.40	1.90	1.55	1.70	1.28	1.28	1.60	1.65	1.75	1.60	1.50	1.40	1.90	2.00	25
50	1.55	1.35	1.80	1.50	1.65	1.25	1.25	1.55	1.60	1.65	1.50	1.40	1.35	1.80	1.90	50
100	1.50	1.30	1.70	1.45	1.60	1.22	1.22	1.50	1.55	1.60	1.45	1.35	1.30	1.70	1.80	100
200	1.45	1.28	1.65	1.40	1.55	1.20	1.20	1.45	1.50	1.55	1.40	1.32	1.28	1.65	1.70	200
300	1.40	1.25	1.60	1.35	1.50	1.18	1.18	1.40	1.45	1.50	1.35	1.30	1.25	1.60	1.65	300
500	1.35	1.22	1.55	1.32	1.45	1.15	1.15	1.35	1.40	1.45	1.30	1.28	1.25	1.55	1.60	500
1000	1.30	1.20	1.50	1.30	1.40	1.12	1.12	1.30	1.35	1.40	1.25	1.25	1.22	1.50	1.55	1000
2000	1.25	1.20	.....	.....	.....	.....	.....	.....	.....	1.35	1.22	1.22	1.20	1.45	1.50	2000
3000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.20	1.20	1.18	1.40	1.45	3000
5000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.18	1.18	1.15	1.35	1.40	5000
10000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.16	1.16	1.12	1.30	1.35	10000
20000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.15	1.15	1.10	1.25	1.30	20000

b. Calculation of Total Flux when Magnet frame consists of two different materials.

In magnet frames made up of two different materials—either of wrought iron cores and cast iron yokes and polepieces; or of wrought iron cores and yokes, and cast iron polepieces; or of any other combination of two of the various kinds of iron in use for this purpose—the calculation of the total magnetic flux is performed by an indirect method.

Let us assume that the two materials used are wrought and cast iron, and consequently denote

by l_w the length of one circuit in the wrought iron portion of the frame, in inches;

" l_c the length of one circuit in the cast iron portion of the frame, in inches;

" A_w the mean area of one circuit in the wrought iron portion, in square inches;

" A_c the mean area of one circuit in the cast iron portion, in square inches;

" $\mathcal{B}_w$ the average magnetic density in the wrought-iron, in lines of force per square inch; and

" $\mathcal{B}_c$ the average magnetic density in the cast iron, in lines of force per square inch;

then we have the equation:

$$at_m = l_w \times f(\mathcal{B}_w) + l_c \times f(\mathcal{B}_c)$$

$$l_w \times f \left(\frac{\Phi''}{A_w} \right) + l_c \times f \left(\frac{\Phi''}{A_c} \right) = Z, \dots (73)$$

a value Z is produced which, in general, will differ from the value at_m obtained by formula (50).

If Z is found smaller than the actual value of at_m , then the value of Φ'' was assumed too small; if larger, then Φ'' was taken too large. A second assumption of Φ'' is now made so that the corresponding value of Z obtained in a similar manner from Table III and formula (73), will be on the other side of at_m , i. e. larger than at_m in the former, and smaller in the latter case.

By properly interpolating between the first and second assumption, a third assumption of Φ'' is now made which will produce a value of Z very near the actual value of at_m . A fourth, or eventually a fifth assumption, will then make the value of Z practically equal to at_m from formula (50), and that final value of Φ'' which satisfies the equation (72) is the required total flux per magnetic circuit of the dynamo.

C. Actual Leakage Factor of Machine.

Being thus able to calculate the total flux of magnetic lines through any dynamo from the ordinary machine test, that is, from its ordinary running conditions, the actual factor of magnetic leakage can be found from

$$\lambda = \frac{\Phi'}{\Phi} = \frac{Z \times \Phi''}{\Phi}, \dots\dots\dots (74)$$

where: Φ' = Total flux through magnet frame, in lines of force;

Φ'' = Total flux per magnetic circuit, calculated from formula (70) or (72) respectively;

Φ = Useful flux cutting armature-conductors, from (1), or (2), respectively;

Z = Total number of magnetic circuits in machine.

The writer, by employing his method of calculating the leakage from the ordinary machine test, formulæ (49) to (73), has figured the leakage-factors for a great number of practical dynamos of which the test data were at his command, and by combining his results with the researches of Hopkinson¹, Lahmeyer², Corsepius³, Esson⁴, Wedding⁵, Ives⁶, Edser⁷, and Puffer⁸, has averaged the above Table V, of Leakage Factors for dynamos of various types and sizes, which is intended to assist the first assumption of the total flux in solving equation (72), but which may also be made use of in obtaining an approximate value of the leakage coefficient for rough calculations.

From this table the general rule will be noted that the factor of leakage is the greater, the smaller the dynamo, which is due to the difficulty, or rather impossibility, of properly dimensioning the magnetic circuit in small machines. In these the length of the airgaps is comparatively much larger and the relative distances of the leakage surfaces much smaller than in large dynamos; the permeance of the airgaps, therefore, is relatively much smaller while the permeances of the leakage paths are considerably larger, comparatively, than in large machines, and formula (4), in consequence, will produce a high value of the leakage-coefficient for a small dynamo.

It further follows from Table V that the leakage factor for various types and sizes of dynamos varies within the wide range of from 1.10 to 2.00, which result agrees with observations of Mavor⁹, who however seems not to have considered capacities over 100 kilowatts.

By comparing the values of λ for any one capacity, the relative merits of the various types considered may be deduced.

Thus it is learned that, as far as magnetic leakage is concerned, the Horizontal Double Magnet Type (column 6) and the Bipolar Iron Clad Type (column 7), are superior to any of the other types, which undoubtedly is due to the common feature of these types of having the cores of opposite magnetic potential in line with each other on opposite sides of the armature, thus reducing the magnetic leakage between them to a minimum.

Next in line, considering Bipolar dynamos, are the Inverted Horseshoe Type (column 2), the Single Magnet Type, (column 4), the Upright Horseshoe Type (column 1) and the Vertical Double Horseshoe Type (column 8).

Of multipolar machines the two best forms, magnetically, are, respectively, the Innerpole Type (column 13), and the Radial Multipolar Type (column 12). In the first named of these types the magnet-cores form a star having a common yoke in the centre, and the pole-pieces at the periphery; thus the distances of the leakage-paths increase the direct proportion to the difference of magnetic potential, a feature which is most desirable, and which accounts for the low values of λ for the type in question.

The most leaky of all types seem to be the Horizontal Single Horseshoe Type (column 3), and the Axial Multipolar Type (column 15).

In the former type the excessive leakage is due to the

magnetic circuit being suspended over an iron surface extending over its entire length, while in the latter type it is due to the comparatively close relative proximity of a great number of magnet cores (two for each pole) parallel to each other.

THE ELECTRIC LIGHT PLANT OF THE MANCHESTER, ENGLAND, CORPORATION.

It was never expected that the introduction of the five-wire system into Manchester would be attended with unalloyed success, but the promoters have had few difficulties to meet, and these were merely troubles incidental to all new electric light undertakings; nothing seems to have arisen that could fairly raise the question of the utility of the five-wire method. The method employed at Manchester differs in some respects from the well known installation of the Rue de Clichy, Paris. Four 100-volt machines are arranged in series, 400-volt machines being employed for the main supply. The outside wires have a difference of potential of 400 volts, the inner wires having between them a pressure of 100 volts. The inner wires are practically the return or balancing wires. The five wires are fed at a number of points throughout the area of supply by means of heavy feeders, the main supply being derived from the large dynamos, though the balancing dynamos besides their compensating functions can also supply power to the feeders. For this purpose they are placed on the various sections of the system and are not coupled to the feeders. Some idea of the arrangement of the machines will be obtained from the diagrams, Figs. 2 and 8.

For the most part the mains, both feeders and distributing, are of

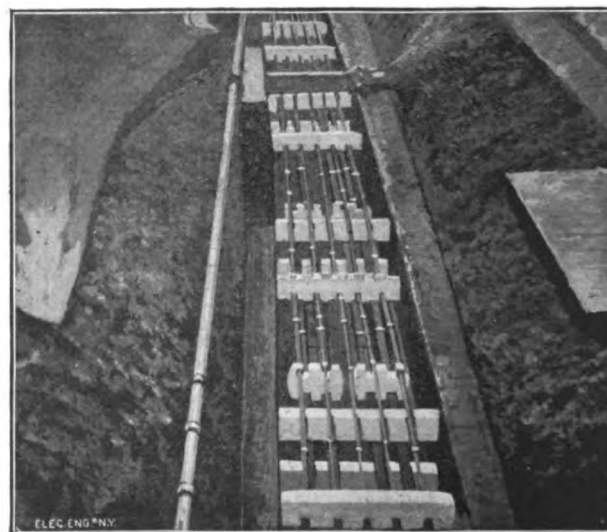


FIG. 1.—MANCHESTER, ENG., 5-WIRE DISTRIBUTION WITH BARE CONDUCTORS.

bare copper strip supported on porcelain insulators, Fig. 1. Where, however, the mains pass under the roadways insulated cables are employed. The types adopted are cables insulated with pure rubber, then vulcanized rubber, special tape, and the whole vulcanized together; then braided flax and taped canvas over all, then coated with preservative compound, the cables being differently colored—to admit of their being easily distinguished one from the other. The minimum insulation tested in water after 24 hours' immersion at 60 degrees Fahr., and one minute's electrification was 2,500 megohms per mile. These cables are drawn into iron pipes in the usual way.

In the station there are four large engines and six smaller ones used for balancing purposes. The four large ones, which are by Galloways, are of the compound vertical type, each having high-pressure cylinders 17 inches in diameter, and low-pressure 84 inches in diameter, with a stroke of three feet. The pistons from these cylinders work on to crank pins placed at each end of a crank shaft, which carries the fly-wheel acting as a pulley, being turned and crowned for receiving link belt, which transmits the power direct to the dynamo, and as these are in close proximity to the engines, jockey pulleys are provided for the purpose of maintaining the requisite tension on the belt. The six small engines are vertical tandem compound condensing engines, working at a steam pressure of 120 lbs. at 120 revolutions per minute.

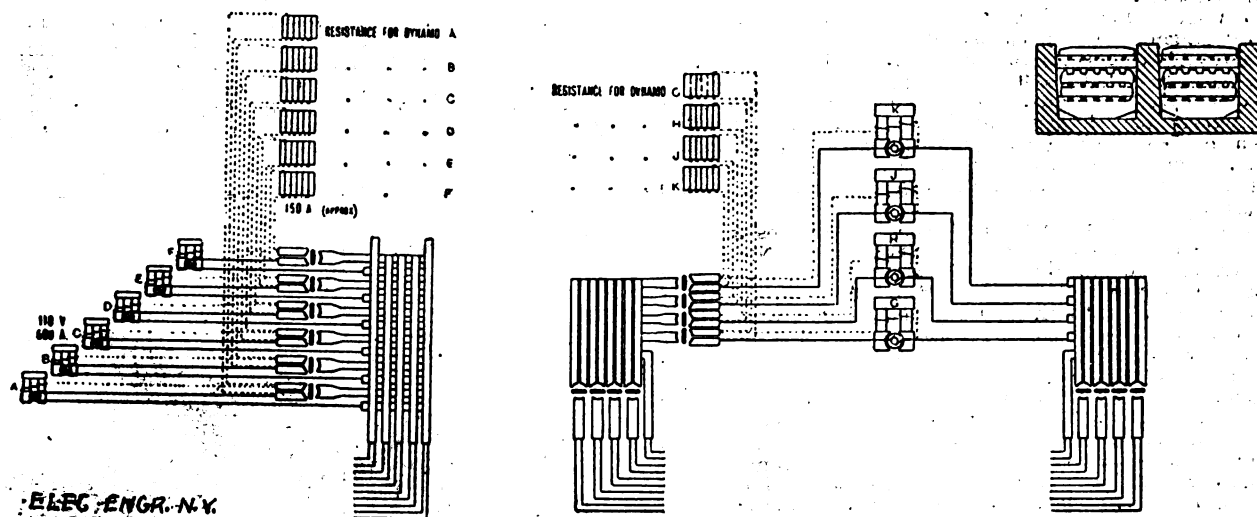
The boilers, by Galloway, are 30 feet by 8 feet, and work at 125 lbs. pressure, and are provided with very complete fittings,

1. Abstract from the London *Electrical Review*.

1. For List of Machines considered see *El. World*, XXIII, p. 675 (May 19, 1894); 2. J. & E. Hopkinson, *Phil. Trans.* 1886, part 1; 3. Lahmeyer, *Elektrotechn. Zeitschr.* IX, p. 89 & 283 (1888); 4. Corsepius, *Elektrotechn. Zeitschr.* IX, p. 235 (1888); 5. W. B. Esson, *The Electrician* (London) XXIV, p. 424, (1890); *Journal Inst. El. Eng.* XIX, p. 122, (1890); 6. W. Wedding, *Elektrotechn. Zeitschr.* XIII, p. 67 (1892); 7. Arthur Stanley Ives, *Electr. World*, XIX, p. 11 (Jan. 2, 1892); 8. Edwin Edser & Herbert Standfield, *El. World*, XX, p. 180, (Sep. 17, 1892); 9. Puffer, *Electr. Review* (London), XXX p. 487, (1892). 10. Mavor, *Electr. Engineer*, (London) April 13, 1894. *Electr. World*, XXIII, p. 615, May 5, 1894.

including Vicker's mechanical stokers. A very unusual feature in the boiler installation is the duplicated arrangement of the entire ranges of steam and feed pipes; in fact, the duplication is so complete that under no possible combination of circumstances can the whole of the boilers or engines be rendered inoperative. The steam pipes are of 18 inches diameter, and are all of wrought-steel welded, with strips double riveted over the weld.

are of the "Edison-Hopkinson" type and are shunt wound with armatures internally ventilated and wound with ^{not alloy is} ~~stunt~~ ^{stunt} bars. The resistance of the armature is .0117 ohm, and of the shunt coils 52.7 ohms; the electrical efficiency is stated to be at full load 97.2 per cent., and at half load 95.9 per cent. In accordance with the contract the machines were officially tested to determine their commercial efficiency, the method of testing being a modification



FIGS. 2 AND 3.—ARRANGEMENT OF MAIN AND REGULATING DYNAMOS, MANCHESTER, 5-WIRE SYSTEM.

The dynamos are among the most striking features of the station. There are four 240-kilowatt machines and foundations are prepared for a fifth. Of these larger machines, two have been supplied by the Electric Construction Corporation and two by Mather and Platt. The former are of the well-known Elwell-Par-

of Dr. John Hopkinson's original motor-generator system, in which the loss in the combination is supplied by a third dynamo placed in series with the armatures of the two machines to be tested; the advantage of this method being that all the measurements are electrical, and that even a considerable error in the

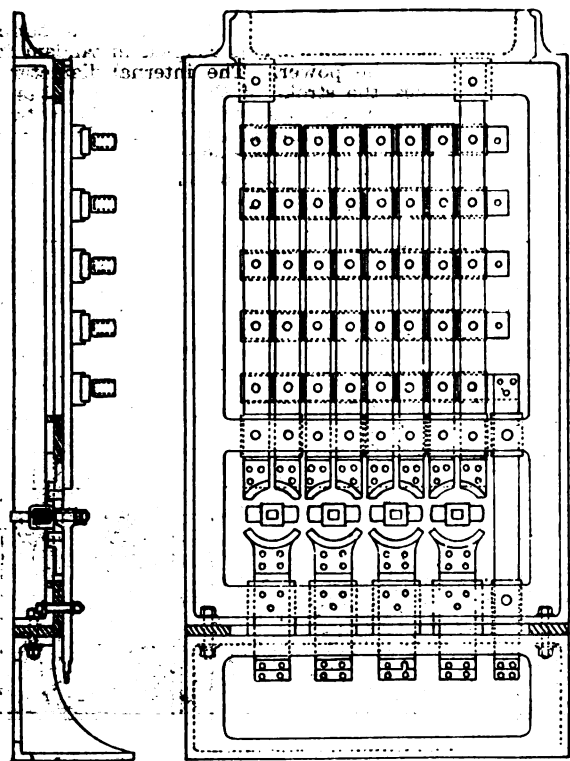


FIG. 4. SECTION OF SWITCHBOARD.

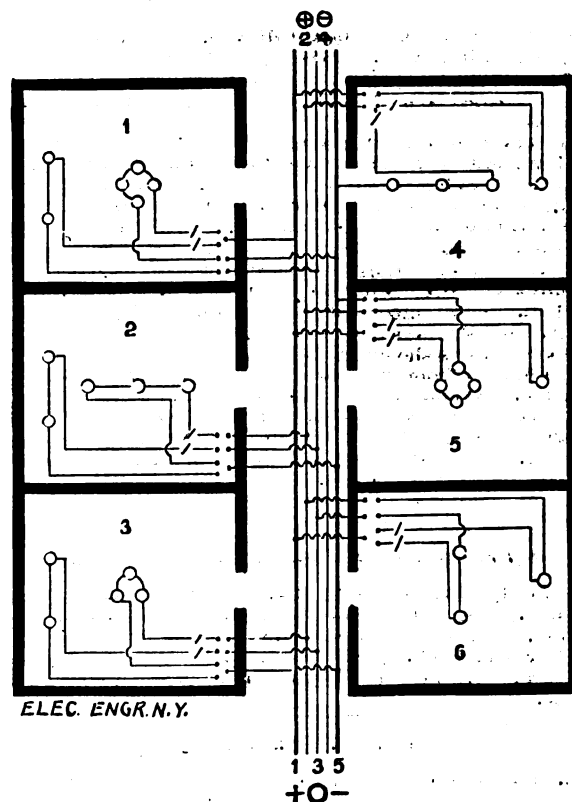


FIG. 5.—WIRING OF MANCHESTER TOWN HALL.

ker type and are designed for an output of 590 amperes at 410 volts when running at 400 revolutions per minute. In addition to these, this company has also supplied the six smaller machines which give 590 amperes at 102 volts at 540 revolutions per minute.

The two large dynamos supplied by Messrs. Mather and Platt have been constructed to give a similar output to the large machines just mentioned. Like the others they are both intended to work on the feeders of the five-wire system. These machines

measurement of the output of the machines cannot cause any error of importance in the final result.

By a series of very careful tests it was proved that the efficiency for the double conversion from electrical into mechanical power and back again of each machine is 90.5 per cent. Hence, the commercial efficiency of each machine is 95 per cent. and the efficiency of conversion 97.7 per cent.

The four motor-transformers used for transferring 100 amperes

at 100 volts from any one circuit of the five-wire system to any other, are also of the "Edison-Hopkinson" type, designed for running continuously at a speed of about 1,400 revolutions per minute.

An electrical crane is used for unloading the coal barges which come up the Manchester and Rochdale canal alongside the boiler house, the coal boxes, each weighing about two tons, being lifted from the boat and unloaded directly into the hoppers of the mechanical stokers.

The main switchboard is of a distinctly novel type, and is specially designed for convenience of extension, the whole board being divided into three separate boards, viz.: Nos. 1 and 2, "feeder" boards, and No. 3, "distributor" board. Each board, Fig. 4, consists of a cast-iron frame, upon which are mounted vertical and horizontal bars of high conductivity gun-metal. These bars are insulated from one another and from the frame by porcelain insulators. The horizontal bars are connected to the dynamos in all cases, and the vertical bars to the feeders, or distributors, as the case may be.

The outgoing mains from the "feeder" dynamos are taken direct to the switches on the horizontal bars of No. 1 board. These switches are designed and arranged so that any feeder dynamo can be used as a motor worked from the mains to start its engine and itself, by having two points to the switch, one of which is connected to the dynamo through a resistance which is switched out when the dynamo has attained its proper voltage. The feeders are taken from the lower point of the switches on to the vertical bars, the other two points of each switch being connected to separate bars. The change over of the feeder from one dynamo to another is effected by inserting a screwed plug through the vertical feeder—which is clear of the switch tongue—into the horizontal bar of the dynamo to be connected, and the feeder switch turned so that the new bar makes contact with the switch tongue. The return feeders are connected to a separate board, similar in all respects to the above, with the exception that there are no dynamo switches.

In the distributor board the horizontal bars are connected to the smaller dynamos, the positive mains through two-way switches, with a resistance as described in connection with the feeder board.

On these horizontal bars are placed the "current indicators," consisting simply of a loaded compass needle and graduated scale, which serve to indicate the approximate amount of current passing.

The distributors are connected direct to the lower ends of the vertical bars, without the intervention of switches, the changing over of a dynamo to a distributor other than that to which it is already connected being effected in the same manner as described for the feeders.

As an example of interior wiring on the five wire system, may be cited the case of the Manchester Town Hall. As the specification provided that no circuits should carry more than 25 amperes, and a large number of the circuits were to be controlled directly from the switchboard in the basement, a very large number of circuits was necessary. After much thought had been bestowed on the matter it was decided to use 36 circuits of 400 volts. This plan meant 200 wires being laid from the switchboard. It became of paramount importance to avoid crossing any of the wires or circuits, and this was done by arranging the leads to take three different courses as shown in Fig. 5.

Every branch from the mains, whether positive, negative, or intermediate, is protected by fusible cut-outs. The wiring of all circuits has been so arranged that when all the lamps are on there is no current passing through the three intermediate wires at the switchboard. The whole of this work has been carried out by Messrs. Fowler, Lancaster & Co.

TELEPHONES ON A WESTERN SHEEP RANCH.

The use of the telephone on Australian sheep ranches is becoming common. Its employment is mentioned on the Clark ranch in Montana, where all the sheep and shepherds are watched and handled telephonically, by means of six stations all communicating with a central point, from which come weather signals, orders, etc.

THE HAWAIIAN CABLE PROJECT.

Details have been received at San Francisco of the British attempt to arrange for laying a cable to Hawaii. The British commissioners now in Honolulu, Sanford Fleming of Canada and J. Mercker, from the colonial office, have submitted their propositions to the government of the republic of Hawaii, asking for a lease of Necker Island, and a subsidy of \$38,000 per year for fifteen years. In return for these grants, they promise to lay a cable and to make the rates for messages one shilling a word, with a reduction for messages sent by the government and for press dispatches. The commissioners ask also a condition from the government that Necker Island shall be ceded to Great Britain in the event of annexation of Hawaii to the United States.

The government of Hawaii is anxious for cable connection, but is not satisfied with the conditions offered by the commissioners. The proposition for conditional cession of Necker Island will not be considered. This condition must be omitted altogether. The subsidy asked is also deemed too large.

A 320 H. P. GAS ENGINE.

THERE has been recently installed in the Pantin Flour Mills, near Paris, France, owned by Mr. Abel Leblanc, a complete gas engine plant, built by Messrs. Delamare-Deboutville & Malandin, of Rouen, France. This plant consists of a gas generating plant, shown in Fig. 1, and an engine, illustrated in the engraving Fig. 2. The gas engine is of what is known as the "Simplex"

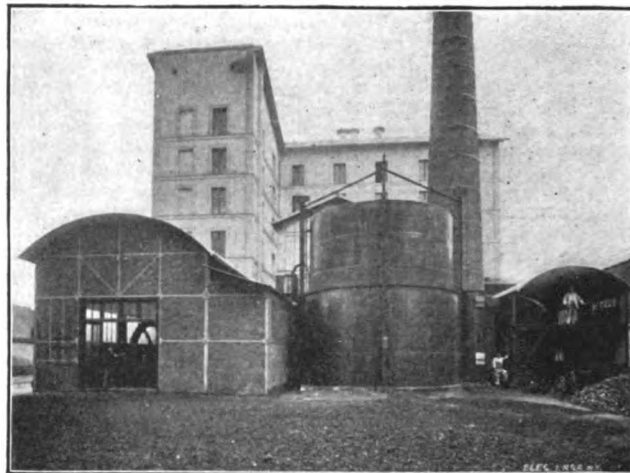


FIG. 1.—320 H. P. GAS ENGINE PLANT AT ROUEN, FRANCE.

type developing 320 indicated H. P. The engine has but a single cylinder so that a number can be coupled in tandem in order to double or triple the power. The internal diameter of the cylinder is 35 inches, the stroke of the piston 40 inches and the shaft revolves at 100 revolutions per minute. The water for the cooling is regulated once for all and is so arranged as to give each part of the engine its proper cooling effect.

The fuel employed in the gas generator is the lean coal of the

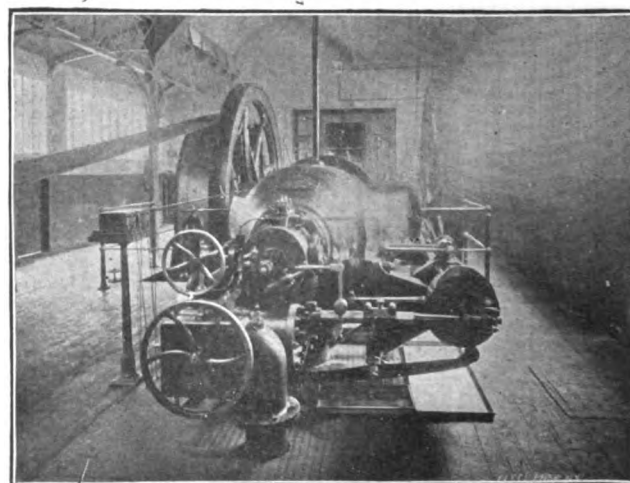


FIG. 2.—320 H. P. GAS ENGINE AT ROUEN, FRANCE.

Anzin mines which was employed in a recent test of 194 hours continuous operation, the mill operating day and night in its regular work. The indicator cards figured up something over 280 H. P., corresponding to about 220 brake H. P. The consumption of coal, making no deduction for ashes, as is usually done, shows $1\frac{1}{2}$ lb. per indicated H. P. and $1\frac{1}{3}$ lb. per brake H. P. hour. The consumption of water during this same test amounted to 1,600 gallons per hour for the cooling of the engine and less than 800 gallons for the washers of the two gas generators. This gives a total consumption of less than 10 gallons per brake H. P.,

whereas the best condensing engines require 50 to 60 gallons of condensing water per H. P. hour under the most favorable conditions.

The fact is here demonstrated that, while a steam engine of 1,000 H. P. and over requires $1\frac{1}{4}$ lb. of coal per indicated H. P. hour a gas engine of less than 800 H. P. requires less than $\frac{1}{4}$ lb. per H. P. hour. The importance of this fact will not be lost sight of by electric light station managers.

Besides operating the mill machinery the gas engine drives directly two dynamos furnishing current for 800 incandescent lamps.

THE EDISON KINETOSCOPE.¹

MANY of our readers are probably familiar with the remarkable results obtained in the Edison Kinetoscope, but there are probably few who have an accurate knowledge of the exact mechanism by which these results are obtained. The principle upon which the kinetoscope depends is analogous to the old form of zoötrope, in which a series of rapidly moving pictures are passed before the eye with an instantaneous break between each, so as to allow the impression on the retina of one picture to fade out before the new picture comes into range. Mr. Edison's pictures are a series of instantaneous photographs in ribbon form; each of these pictures has a dimension of 2 x 8 centimeters and the positives are mounted on thin flexible celluloid bands. These bands form a long ribbon, which, during the operation of the machine, runs at high speed, driven by wheel work. Forty-six photographs thus pass before the eye in one second or 2,760 per minute.

The kinetoscope consists of a box divided into two compartments, one containing the motor, as shown in Fig. 1, and the other the ribbon carrying the instantaneous photographs, Fig. 2. In Fig. 1, will be seen an electric motor C, of the Edison type, of eight volts, which is operated by accumulators or a primary battery. The current passes through the resistance D which can be varied to increase or decrease the intensity of the incandescent lamp; the latter illuminates to a greater or lesser degree the celluloid ribbon, depending upon its thickness and transparency which are very variable. Opposite the motor C is the apparatus B, which starts the machine going when a coin is dropped into a slot A provided for that purpose, but which need not be described in detail here.

In the upper part of the compartment, shown in Fig. 1, will be noticed the metal disc V, which forms a screen in front of the ribbon R. The small incandescent lamp which illuminates the ribbon by transparency, is shown at L. The eye piece O, into which the observer looks, is mounted directly above the conical tube E. To operate the machine, the electric motor is set in operation, which starts the circular disc V revolving at a very high rate. The latter is provided with a slot F which allows the observer to see the photographs on the ribbon R every time that this slot comes in the field of view. Although there is only a single slot in the

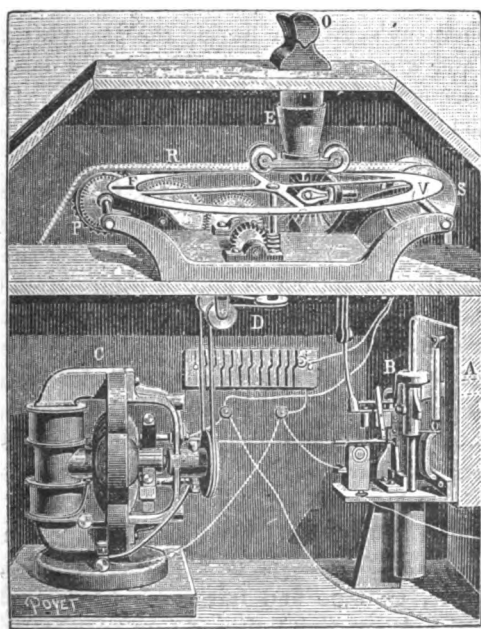


FIG. 1.—THE EDISON KINETOSCOPE.

disc it turns at such high speed that the eye of the observer is not aware of the rotation of the disc and sees the successive photographs as if they were continuous. The photographic ribbon passes

1. From *LaNature*.

ing over the pulleys P and S, is in contact with the horizontal disc to which it is geared so that its speed is exactly timed to that of the disc. The thin ribbon is about fifteen metres

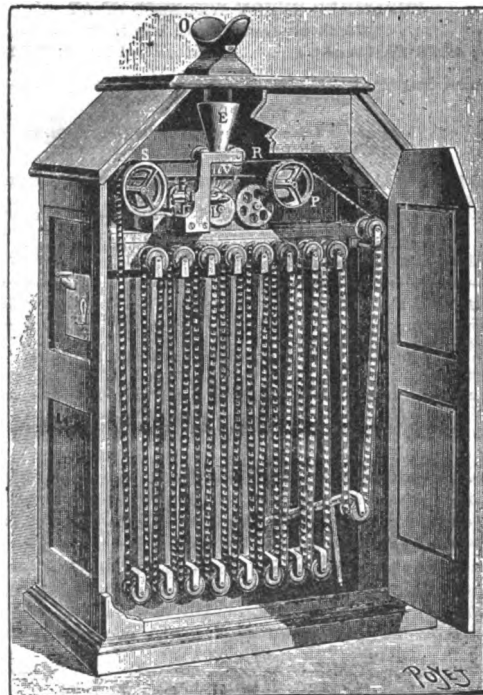


FIG. 2.—THE EDISON KINETOSCOPE.

long and runs over pulleys, as shown in Fig. 2. In one of the scenes depicted in the kinetoscope, representing a scene in a barbershop, there are no less than seventeen hundred poses.

ELECTROLYTIC COPPER AT THE ANACONDA MINES.

We understand that the electrolytic copper refining plant of the Anaconda mine, at Anaconda, Mont., which has a capacity of 50 tons a day, is nearly completed; some portions of it have been in operation since July last, and have produced about 5,000,000 pounds of copper. This plant has been adapted to the Thofehrn system, Mr. H. Thofehrn being now the manager of the Anaconda Electrolytic Works. It is said that the cost of refining is \$12 per ton of 2,000 pounds, or say 0.6 c. per pound. A portion of the refined copper is shipped in the form of wire bars, and the balance in crude plates as they leave the electrolytic tanks. It is said that the company is so well pleased with the result of the work that it is preparing to build a large plant for the same process at Great Falls, Mon., where Belt coal is obtainable at about \$1 a ton, and there is an abundant water power. It is understood that the railroad company agrees to carry the copper, delivering it at Great Falls in transit to the East, and carrying forward the refined copper without any extra cost.

The Anaconda company, says the *Engineering and Mining Journal*, is thus preparing to refine its entire output, as indeed most of our producers now do. The outlook for foreign refiners to get crude material in this country is therefore, we are happy to say, very poor. We will soon be shipping only refined material, and a little later on we hope only manufactured material, and will probably bring the crude material from Europe instead of sending it there. The European metallurgical works, which have heretofore depended upon this country largely for their raw material, will have to look elsewhere, and as there is no other country producing the quantities that we formerly shipped, it would seem as though a good many of the European refiners are likely to be without occupation. The Mexican raw material will certainly come to this country for refining, and a good deal of that in South America will also come here.

HOW TO FOOL WITH ELECTRICITY.

A SPECIAL dispatch from Utica, N. Y., of Oct. 25 says: Stewart A. England, seventeen years old, was instantly killed to-night by a shock of electricity received from the combination knob of Jeweler Bernard Goldstein's safe. Goldstein had connected the safe with the wire, furnishing a current to the motor running his lathe, as a protection against burglars. England and a companion were in the store examining some goods, and the latter dared England to touch the knob. He touched the combination and immediately fell dead.

THE ELECTRICAL ENGINEER.

[INCORPORATED]

PUBLISHED EVERY WEDNESDAY AT

203 Broadway, New York.

Telephone: 1323 Cortlandt.

Cable Address: LENGINEER.

Geo. M. PHELPS, President.

F. R. COLVIN, Treas. and Business Manager.

Edited by

T. COMMERFORD MARTIN AND JOSEPH WETZLER.

Associate Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—630 Atlantic Avenue, Boston, Mass.

Western Editor and Manager, C. KAMMEYER, 1439 Monadnock Building, Chicago, Ill.

New York Representative, 203 Broadway, } W. F. HANES.
Philadelphia Representative, 916 Betz Building, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada, - - - - - per annum, \$3.00
Four or more Copies, in Clubs (each) - - - - - 2.50
Great Britain and other Foreign Countries within the Postal Union " - - - - - 5.00
Single Copies, - - - - - .10

[Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1898.]

EDITORIAL ANNOUNCEMENTS.

Addresses.—Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of THE ELECTRICAL ENGINEER. Communications for the attention of the editors should be addressed, EDITOR OF THE ELECTRICAL ENGINEER, 203 Broadway, New York City.

Communications suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.

VOL. XVIII. NEW YORK, NOVEMBER 7, 1894. No. 340.

CONTENTS.

EDITORIALS :—

	PAGE
Western Union Figures.....	378
A Contemporary on the Convention.....	379
Gas Engines for Central Stations.....	379
The Manchester 5-Wire Station.....	379

ARTICLES :—

McGill University Electrical Engineering Laboratory (Illustr.).....	369
Electrical Machinist Practice.—VIII. (Illustr.).....	371
Magnetic Leakage in Dynamo Electric Machinery.—IX. (concluded).....	372
The Electric Light Plant of the Manchester, England, Corporation (Illustr.).....	374
A 300 H. P. Gas Engine (Illustr.).....	376
The Edison Kinetoscope (Illustr.).....	377

ELECTRIC TRANSPORTATION DEPARTMENT :—

The T-Rail Track Construction of the Terre Haute Electric Railway.....	380
The Working Expenses of Electric and Cable Railways.....	382
To Newark, N. J., by Trolley—Lighting and Railway Construction at Helena, Mont.—New York to Camden by Trolley.—Tampa, Fla., Lighting and Railway Combination.....	383
Another Electric Road for Saratoga.....	386

NEWS AND NOTES :—

Telephones on a Western Sheep Ranch.....	376
The Hawaiian Cable Project.....	376
Electrolytic Copper at the Anaconda Mines.....	377
How to Fool with Electricity.....	377
The Searchlight on the Paris.....	384
Duty to be Paid on Educational Storage Batteries.....	386

LITERATURE :—

Foster's "Central Station Bookkeeping and Suggested Forms".....	383
---	-----

MISCELLANEOUS :—

Theory of the Synchronous Motor (Illustr.).....	C. P. STEINMETZ. 384
Theory of Two and Three Phase Motors.....	LIEUT. SAMUEL REBER. 384

LEGAL NOTES :—

Rights of Electrical Companies Occupying Public Highways.....	385
Last of the Feeder and Main Case.....	385
Against the "Huckleberry Road".....	385

LETTERS TO THE EDITOR :—

Danger of the Rules of the Underwriters' International Electric Association, Covering the Use of 500-Volt Fuses (Illustr.).....	W. E. HARRINGTON. 385
The Training and Education of Electrical Engineers.....	E. P. ROBERTS. 386

SOCIETY AND CLUB NOTES :—

Meeting of the New York Electrical Society.....	386
---	-----

TRADE NOTES AND NOVELTIES AND MECHANICAL DEPARTMENT :—

The Morse Rotary Engine (Illustr.)—Brown & Sharpe Mfg. Co.—The Hatch Electric High and Low Water Indicator.—Hubley Electric Railway Material.—Himmer & Anderson.—New England Notes.....	387
The United Electric Improvement Co.'s New Factory.—The Biddle Electric Car Lighting System (Illustr.)—New York Notes.—Philadelphia Notes.—Western Notes.....	388

WESTERN UNION FIGURES.

THE recent activity in electric railway work has prevented the annual report of the Western Union Telegraph Co. from receiving much attention at the hands of electrical people; but the figures are interesting and important, as well as encouraging. They are remarkable when contrasted with the figures of the English Postal Telegraphs, whose total deficit for the year, including interest at 3 per cent. on the capital, was \$2,300,000; and although as compared with the previous year, the English revenue had increased \$230,000, the expenditure had increased \$360,000. They are the more remarkable when we remember that in this country, too, the Western Union has no monopoly but has had to meet the intelligent competition of so well equipped an antagonist as the Postal Telegraph Company. We are not aware of any statistics made public as to the business of the latter company. We have heard it said that it makes a profit of not less than \$1,000 per day, which is not a high figure, and which at the Western Union basis of 7 cents profit per message, would imply that the Postal Co.'s lines carry not less than 5,500,000 messages a year, or about one-tenth of the business done by the Western Union. The company may in fact do twice as much, or one-fifth of the business of the Western Union, but we should be very much inclined to doubt it, despite an obviously rapid growth. We suggest these figures here chiefly for their bearing on the Western Union statistics.

According to the annual report, the Western Union business runs as follows :

	Messages.	Receipts.	Expenses.	Average Toll per message.	Average Cost to Co. of message.
1892.....	62,367,298	23,706,404	16,807,887	81.6	22.3
1893.....	66,561,858	24,978,442	17,435,405	81.2	22.7
1894.....	58,632,337	21,332,655	16,060,170	30.5	23.3

The company's growth during the past year in mileage of poles and wires is quite insignificant, and does not enter into the account in any degree, though it is worthy of note that 10,000 miles of new copper wire are being strung now, on trunk routes, to be ready by January 1. It will be seen from the above table, that the Company's business has fallen off about 8,000,000 messages from the total of 1893. The question for the Company and for the investor, is whether that falling off is due to competition or simply to the state of trade and industry. We incline to the latter explanation, as the decline of only 8 per cent. is far below that which other enterprises of all classes have experienced, especially the railroads. In other words, it would seem that by careful and vigilant management, the Western Union has more than held its own, and that the Postal Co.'s business has been largely new or of a kind that for one reason or another the Western Union Co. could not get. Another inference is that in this instance, as in so many others, genuine and fair competition has done no harm but has been stimulative of new business even in the worst of bad times. General Eckert has no reason that we can see for fearing any comparison of affairs under his presidency with the conditions existing under his predecessors, but, on the contrary, has cause for congratulation

in steadily maintaining 5 per cent. dividends derived from the earnings of a well-organized system.

But how small, after all, this great telegraph industry is! Adding to the Western Union 58,600,000 messages enough for the Postal system to make a round 70,000,000, it is found that the average is barely one per head per annum for the population of the country. It is safe to assume that the telegraph can and will be further developed; but there does not appear to exist here a set of conditions inviting governmental monopoly and control. On the contrary, our conviction is that had the Western Union Co. been a government department during the present severe depression, it would have added another burden of deficit to the load under which the Treasury has been staggering.

A CONTEMPORARY ON THE CONVENTION.

Our usually even contemporary, THE ELECTRICAL ENGINEER, seems to have been suddenly seized with a severe attack of dyspepsia, and the Atlanta Street Railway Convention is the unexpectedly large meal that caused this biting indigestion. A half column editorial is devoted to criticising everything above, below and around the convention—and then with beautiful inconsistency some two columns are devoted to interesting and intelligent descriptions of "striking features." On second thought, our good neighbor may decide there was not very much wrong with the convention, but there may have been some miscalculation in its own advance preparation for handling these important proceedings satisfactorily. *Hinc illae lachrymae.* — N. Y. Electrical Review.

It all depends upon the point of view. If one went to Atlanta prepared for a régime of cakes and ale, picnics and free lunches, the Convention would no doubt appear altogether a great success. If one went prepared for a share of serious work also, the Convention appears as a partial failure—dyspepsia or no dyspepsia. Our understanding is that such conventions are most successful when they do solid, steady work, and carry out their programme with order and dignity. It will suffice to say that of the eleven excellent papers got ready for the meeting, no fewer than five were crowded out and read by title only, and the discussions throughout were reduced to nothingness. This is certainly not complimentary to the authors. In previous years, the A. S. R. A. has done better than this; it will do better again; and we do not think that criticism is improper or dyspeptic from those who believe it has something else to live for beside junketing. Optimism is certainly a great virtue, and our contemporary's keen appreciation of the social and convivial side of life does it infinite credit; but in the present case we regret we cannot see things through the wine-colored glass that it uses.

GAS ENGINES FOR CENTRAL STATIONS.

In the plan proposed by Messrs. Thwaite and Swinburne for distributing electric current generated in the Midland coal fields of England to London and the southern counties, which appeared in these columns some months since, it was contemplated not to employ steam engines as the prime movers but to use gas engines supplied from gas generated from coal at the pit's mouth. The calculations showed that the fuel economy attainable with the gas engine made that type of prime mover the only one worthy of consideration; hence in formulating their plan of a

10,000 H. P. station they adopted a standard gas engine unit of 300 H. P. The selection of this size of unit was no doubt considered conservative in view of the fact that it was contemplated to employ two gas engines of 150 H. P. each coupled to the same crank. In order to demonstrate the rapid advances which are going on in the gas engine field we describe this week a gas engine of French manufacture, having but a single cylinder and developing over 300 H. P. with ordinary producer gas. A number of gas companies operating electric lighting plants in the United States employ gas engines for driving their dynamos, but the question seems pertinent whether the time has not arrived for some electric light and power companies operating steam plants, to consider the advisability of adopting the gas engine where coal of the proper quality can be had at reasonable cost. For, notwithstanding the use of the most approved steam generating apparatus, one cannot help remarking the high fuel consumption per indicated horse power still prevalent in electric plants, as brought out in the statistics submitted on this point at the last meeting of the National Electric Light Association. Taking the figures there given and comparing them with the result obtained in the 300 H. P. gas engine plant described, it is not difficult to foresee one direction in which relief will be sought.

THE MANCHESTER 5-WIRE STATION.

ENGLISH towns are rapidly adopting the electric light, and in many cases the work is undertaken by the municipality. This practice differs from methods pursued in the United States under similar circumstances. The English municipalities as a rule employ consulting engineers with the result that we note a great variety of methods of distribution, depending upon the leanings or hobbies of the consulting engineer. Thus in a recent issue we described the station erected by Mr. Ferranti's company at Portsmouth, operated by means of the alternating current, part of which was rectified for arc lighting. In this issue is described the Manchester station operating on the 5-wire plan and for which Dr. John Hopkinson was consulting engineer. This system is now employed in a few instances in Germany and France, but no serious attempt has yet been made to introduce it in central station work in this country. The 5-wire Siemens & Halske plant at the World's Fair at Chicago last year served to show what the system could do and it cannot be denied that it possesses great flexibility. On the other hand in a large installation the multiplication of dynamos and conductors and the regulating apparatus must of necessity introduce more or less complication, and greater than that obtaining in the systems now generally in vogue. Besides, when we consider what has recently been accomplished in this country by means of the booster in connection with the 3-wire system, the advantages of the 5-wire system dwindle. We are pleased to learn that the Manchester installation is working well, and with the variety of types now in operation in England, the lapse of time will afford a means of ascertaining the relative merits of each, and will enable the electrical engineer finally to evolve the best all-round station.

ELECTRIC TRANSPORTATION DEPARTMENT.

"THE T-RAIL TRACK CONSTRUCTION OF THE TERRE HAUTE ELECTRIC RAILWAY."

BY RUSSELL B. HARRISON.

The present standard of "all steel" T rail track construction of the Terre Haute Electric Railway, not only has no equal in this country, but is so far in advance of anything yet attempted in the way of street railway track construction, that I feel a brief outline of our work on the problem prior to reaching the present standard, will not only not be out of place, but will prove of real interest. Our motto has been, not how cheaply, but how well we could construct our tracks in the streets. The public have appreciated our efforts and sustained us loyally.

There has been in the past too much attention paid to motors, generators, cars, power-houses, etc., and too little to the foundation for successful and economical operation—a perfect track. It seems strange that street railway track construction should drift so far away, in theory and practice, from steam railway track construction. One had but to study the wonderful display showing the development of track construction, in the Transportation Building, at the World's Fair to acquire a liberal education on the subject. The Terre Haute road has indeed had a fortunate experience. Its management early realized, that successful track construction should approach as far as possible, and not deviate from, further than necessary, the best steam railway track construction. So to-day the Terre Haute road is an all T-railroad, and every block of track in paved streets of so durable a character that it will last for years, with a minimum of repairs.

Terre Haute, although a small town at the close of the great civil war, was very enterprising and determined to have a street railway. A company was incorporated for this purpose in 1866, with ample capital, and commenced to lay track early the following year. It is an interesting fact in connection with the present low price of steel, that the side bearing, flat iron rails purchased by the company in 1867, cost \$108 per ton. These rails were used about twenty years and then, thirty-eight pound girder rails were substituted. The franchise of the company does not contain any requirements as to the style, character or weight of the rails. While there has been no expression from the public on the subject, the management feared that the general and popular prejudice against the use of T-rails in the streets would appear in Terre Haute. They, therefore, hesitated about so radical a change, but appreciating the good results that would come from the use of such a rail, they decided to place a trial order. No publication was made of the fact that it intended to use T-rail. The first T-rail laid by the company was on South 3d Street, in the fall of 1890. This rail was laid preparatory to changing the motive power from horse to electricity. The old girder rail on 3d Street was taken up, new ties distributed, and when everything was ready the T-rail was distributed in a matter-of-fact way, as if it was the only rail that could be used, and a force of men put to work in laying them. The Mayor of the city came around shortly, reports having reached him as to the company laying a steam railway track, and when he saw the reports were true, said with some excitement, "What are you doing here, putting a steam road in our streets?" The superintendent, who was on the spot, was equal to the emergency, and replied pleasantly, but earnestly, that the track was being built for an electric railway. The mayor replied that that could not be the case, as the rails were steam road rails. The superintendent then informed him, that these T-rails were the only rail adapted for the successful operation of electric railways, and while it appeared to be the steam road rail, it was in reality very much lighter (the section being forty pound T) than a steam road rail. Further explanations satisfied the Mayor, and convinced him as to the merits of the T-rail. In a short time he not only became interested, but enthusiastic, and brought councilmen to see the rail, and explained to them its advantages for electric street railway service. They in turn brought prominent citizens and others to look at it, and thus by tact and good management the T-rail was introduced.

A description of the laying of this first T-rail track will prove of interest. It was a forty pound T-rail, laid on oak ties, 5" x 7" x 7", with three feet space from centre to centre. The rails were laid without proper regard to having the end of the rail rest on a tie. Planks, 2" x 8" x 12", were laid on both sides of the rail. On the inside, the planks were nailed to the ties, and on the outside blocks were nailed to the ties to raise the plank to a level with the rail, to provide vehicles an easy crossing. Ordinary flat splice bars were used with the rails. The rails were bonded

with three-eighths inch galvanized bond wire, with a single bond to the joint. They, in turn, were wired and soldered to a supplementary wire, of one-quarter inch, galvanized, stranded iron wire, each alternate joint being soldered and wired from both rails of the track. In the single track, the supplementary wire was in the centre of the track, and in the double track between the tracks. The track was covered in with good gravel.

One year's experience demonstrated that planking was unnecessary; that gravel, which is found in great abundance under and about Terre Haute, made—with a little clay that is found above it—a superior substitute for the plank, and protected the rails better, in enabling vehicles to pass along, and to cross the track easily and without injury. This substitute only required occasional attention in filling up low spots to maintain a level roadway. In two years, the planks were badly decayed and warped up at the end, and as the track was thoroughly overhauled at that time, the planking was taken up, and gravel substituted.

At the end of two years' service of the track, it was found, in making repairs, that the galvanized iron, supplementary ground wire was rusted out and gone for various distances, making a return circuit an impossibility, and as we only had the rails to depend upon, which, in themselves, for this purpose, are not sufficient, this trouble not only reduced the efficiency of the circuit, but caused frequent burnouts of the armatures and fields. It grew to such an extent it was found necessary to rebond this track, and it was decided, at the same time, to dig up and repair the entire track, and increase the number of ties by one-third, and, at the same time, give careful attention to having the ties under and properly supporting the rail joints. Tinned, No. 00 copper wire was substituted for iron, as the bond and supplementary wire. Good gravel, with a little clay, was substituted for the plank along the rail, and the substitute has given very much better service than the planks have ever done. This section of the road, as rebuilt, is in daily use now, and giving good service.

The era of street paving did not set in, in Terre Haute, until 1892. This was not because Terre Haute lacked in enterprise and progressiveness, but was because the town was situated on a high bluff, fronting the Wabash River, and had, with the gravel sub-soil, good drainage and good streets. When it was decided to pave Wabash Avenue and Main Street with brick for fifteen blocks, it became necessary for the company to take up its girder rail. Our experience, thus far, with T-rail, had been so satisfactory that it was decided to continue its use on the following method.

Rail.—About this time the Illinois Steel Company brought out their sixty pound Shanghai T-rail, which, as it was five and three-quarters inches high, permitting paving without chairs and direct spiking of the rail to the ties, was very promptly adopted and ordered.

Ties.—Carefully selected oak ties 5" x 7" x 7" were used.

Foundation.—After excavating for the track, the ground was rolled by a heavy fourteen ton steam road roller. Then six inches of broken stone was placed in position as a bed, and rolled by the fourteen ton steam road roller.

Track.—Then the ties and rails were placed in position and raised to grade by tamping screened broken stone underneath, spaces between ties were filled with broken stone and rammed to position.

Bonding.—Single bonds were used of seven-sixteenths inch galvanized iron wire, and a supplementary wire of No. 00 tinned copper wire.

Paving.—On top of the broken stone, screened sharp sand was placed, and with one-inch hose this sand was washed into the interstices of the stone. After drying, the sand was brought up to an even surface by a fresh deposit, and it was then smoothed to even surface and the desired thickness by a mould board. Then vitrified bricks were placed in position, leaving them somewhat higher than the rail. They were driven into the cushion of sand by means of hand rammers, with a square piece of boiler plate placed on top of them, to force all to the proper level. The sand cushion permitted the bricks to crown evenly from centre towards each rail to afford proper drainage. A special brick with one corner cut off with sloping angle to give space for flange of wheel to run in, was laid next to the rail. These bricks were not the shape of the special nose brick now used, and only set against the lower edge of inside of head of rail. The space between the brick and web of rail was filled with grouting. Bricks of regular size were laid between. After the bricks had been rammed and rolled to proper position, a grout of best screened sharp sand and Portland cement with water, made to such flowing consistency as to percolate all the crevices, was poured over them, and by brooms

1. A Report presented before the American Street Railway Association, Atlanta, Ga., Oct. 17-19, 1894.

pushed into the openings. When thus wet, the bricks were solidly united and they cannot be separated, except with great difficulty. A finishing coat of sand was thrown over the entire surface, and traffic kept off for one week. After thoroughly setting, the sand was swept off and the street opened for traffic. The street between the tracks and curbstones, as well as between the tracks, is one solid mass of concrete and brick from centre of street to curb, and will sustain great pressure. Since this track was laid, our experience with it has demonstrated that it could have been improved in one particular, viz., the sand and broken stone should have been united with cement into regular concrete. For we have found since the paving was completed that the use of the water on the sand, did not wash it thoroughly into interstices of the broken stone. In time the sand dried and settled down into the spaces, and while the ties and the paving immediately over them have remained firm and solid, the paving between the ties has settled slightly, without breaking or disturbing the concrete holding them together. This track laid in Wabash Avenue, the principal street in the city, has had two years' severe service, and has been thoroughly tested in every particular, and thus practically demonstrated its great success and merit. Vehicles, carriages and wagons can pass along the rail, and turn in and out at will, without jar or wrenching. It can be crossed at right angles, or at any angle with equal ease and comfort. A continuous traffic over it has caused no perceptible wear, and the cars glide over it without oscillation, as smoothly as when first laid.

Our next experience with T-rail construction was in a street paved with asphalt, when a half mile was laid in the fall of 1892, and a mile more in the spring of 1893.

While asphalt presented some new problems, the T-rail, ties, joint plates, bonding and supplementary wire were the same as on Wabash Avenue; the foundation was improved by making it of concrete, six inches below the ties. This broken stone concrete was also placed between the ties, and up to a point to allow space for four inches of asphalt packed into position.

The asphalt was brought up to and in contact with the rail on the outside for the entire distance of half a mile. On the inside of the rail for the first half mile the vitrified brick used on Wabash Avenue, with corner cut off on a sloping angle, was used to give flange space, and between the two ends of the brick asphalt was used in the regular way. On the last mile, the merits of the Haydenville blocks having been brought to our attention, it was decided to use them both inside and outside of the rail, and while it makes a smoother finish to the rail than the brick or asphalt, our experience proves that these blocks do not have the wearing qualities of the brick. This track and asphalt paving are beautiful in finish, and of unusual strength and smoothness. It is a genuine pleasure for passengers to ride over this track, for there is no motion perceptible except the forward motion.

Our next experience with T-rail construction was during the year 1893, in several streets paved with brick. The rail was sixty pound Shanghai, and rail plates, bond wire and supplementary wire were the same as in the street laid in asphalt. The foundation was six inches broken stone concrete below these ties, and about five and a half inches additional concrete between the ties. It also covered slightly the top of the ties. The foundation for this brick track was further improved by pouring a thin wash of sand and cement over the top of the foundation before placing the sand cushion thereon. This gave the foundation, track, ties and concrete a solid union. The brick paving was laid in a manner similar to that on Main street. Instead of angle cut brick for flange space Haydenville blocks were placed on the inside of the rails, one and a half inches distant therefrom. The lower part of the space between the Haydenville block and rail was filled with sand concrete, rammed down tight. On top of this an inch of tar was placed. The hollow spaces in the Haydenville block were filled with sand concrete before placing in position, and the space in the centre of the track between blocks was laid with vitrified brick in the regular way. This track is perfect in strength, smoothness and durability. A year's experience with the Haydenville blocks on these business streets show that the glazed upper service wears too rapidly, and their use has been entirely discontinued.

While this track, just described, was in every way superior, I gave further study to where additional improvements could be made, causing the following changes: 1st, to use a heavier rail with wider head; 2d, to substitute metal glass ties for wood; 3d, to secure greater rigidity and evenness in rail ends; 4th, a firm and permanent hold on the rails without the use of nuts and bolts; 5th, in paving, a better brick and of such shape as would provide better flange room and contact with the web of the rail. These changes brought us to an all steel T-rail track.

Rail.—When the Illinois Steel Company, brought out the seventy-two pound Shanghai T rail which was an improvement both in weight, strength and the width of the head of the rail over sixty Shanghai T of same make it was immediately adopted as the company's standard and was used in our latest and best T-rail track construction. The Shanghai rails of this company's make are so well known that a description is hardly necessary, but as this paper will be read by some who have not seen sections of them, I will give the dimensions of the seventy-two pound rail.

The rail is six inches high; the base is five inches wide; the top or head is two and three-eighths inches in width. The web from where the turn begins is three and one-half inches. The long web permits the rail to rest on the ties and brings the top of rail to proper level for paving with brick, asphalt or granite blocks. In this track the rails are laid broken jointed. The seventy-two pound rail has a wider head which gives better contact, and wider bearing surface for the wheels. The edges of the wheels do not nick or chip out as with the lighter rails with narrower heads.

Experience with the narrow head rails demonstrates that by wear an outer flange is formed on the wheel and that this outer flange is very destructive to the life of special work and the wheel. The wider rail head is also better for gravel or macadamized streets as it gives no opportunity for the stones lying adjacent to the rail to nick the outer edge of the tread of the wheel.

Foundation.—The foundation of a track is to a larger degree than any other part responsible for its wearing qualities, and this fact has not been lost sight of in our work. Good rails, ties and joints cannot alone make a track or properly sustain it so as to keep it level and give good wearing qualities; therefore under the all steel track it was determined to place a heavy foundation of the best material. After the necessary excavation the ground was rolled with a heavy fourteen ton steam road roller. Then eight inches of broken stone concrete was placed in position and allowed to set. Then the rails, ties and joints were distributed and connected together and when the track is completed it is brought to the required grade or level by putting blocks under the rails at intervals to bring track to proper grade. Then four inches of broken stone concrete is tamped under the ties and under the rails; after the tamping process is completed the inequalities of the surface are filled with concrete and the whole leveled up with concrete over the top of the ties and pounded to a level surface with a wooden rammer and allowed to set.

Ties.—The ties are steel and double corrugated and heavily coated with tar while hot. They are made two inches high, seven inches wide and seven feet long for straight line work, and are laid fifteen inches between centres. For special work the ties vary in length as the necessities require, up to twenty feet or more. The metal of the tie is one-half inch thick. These ties were manufactured by the Daniels Steel Tie Company, of Youngstown, O. The rails rest on and are fastened to the ties by clamps with off-sets to fit the base of rail. These clamps are secured and adjusted to the top of the tie by specially made bolts with oval shoulder inserted from bottom of tie with the head below and the nut on top, which permits a powerful box wrench being used to draw the nuts on bolts to a permanent position.

In using these steel ties in connection with the Wheeler rail joint a mechanical difficulty arose, but was overcome in the following way, after some study: The Wheeler joint has a thickness of three inches below the rail base, and in laying track with broken rail joints a straight tie would not answer. At first we thought it would be necessary to use a wooden tie under rail joints, but by devising a special tie, we were able to have them all of metal. The special steel tie for use under joints was adjusted to the necessary levels, by bending it down in the centre three inches by an easy off-set. In laying the track these special ties were easily placed in position and gave perfect satisfaction. The clamps and bolts were the same as on straight line work.

Joints.—A great deal of attention was given to the subject of securing a good rail joint for this all steel track, and after examining many devices we selected the Wheeler rail joint made at Marion, Ind., as it did away with the bolts and nuts, and embodied the best of all mechanical principles—that of the wedge. These joints at that time had not been made for Shanghai rails or for steel ties, but I overcame these difficulties by designing a new joint to be used with these rails and ties, and secured in this new pattern more bearing surface on the tie, by having the bottom of the joint made to fit the corrugations of the tie. The joint consists of two parts, one of which is keyed on to the other. The larger or heavier part used on the outside of rail has two lugs, that fit in the angle joint holes nearest the ends of rails. After it is placed in position, the lighter part is keyed on with a large maul and it holds the rails rigidly. Then the tie is placed under the joint and is fastened to it in the regular way, with the exception that the clamps have longer off-sets, the holes in the ties for the bolts are also wider apart, on account of the width of the base of the joint. The joint has corrugations on each side at right angles to the rail, which gives it great strength. The joint is made of the best malleable iron and weighs thirty-two pounds complete.

Bond and Supplementary Wire.—Iron wire, having proved unserviceable and unsatisfactory, the heaviest copper wire was used in connection with this steel track. Double bonds of No. 0000 copper wire were used at each rail joint, one in the upper and one in the lower part of the web of rail. These bonds were soldered and connected to the No. 00 tinned copper supplementary wire, that has been adopted as standard.

Paving.—When the foundation is completed and the track set in it, as just described, nothing remains but the paving to complete the track and street for use. The all steel track was laid on 9th Street a business street leading from Wabash Avenue or Main Street to the Union Depot, and brick was, therefore, selected for

the paving material. This brick pavement was laid as previously described, and needs no further description.

As the use of Haydenville block has been abandoned and the angle, nose-cut brick did not touch the web of the rail, I designed a special shaped brick that has many advantages, combined with the same wearing qualities as the brick on each side of the tracks.

Drainage.—In the earlier laid track in paved streets, rapid and proper drainage of the tracks was not provided for. The paving was crowned to the centre of the tracks and followed the slope of the streets, but when the lowest point in the street was reached, no provision was made to carry the water quickly to the sewer. In this new track, proper provision is made to get rid of the water from rain, snow and street sprinkling, quickly and effectively. In the centre of each track, at the lowest point in the grade of each street, an eight-inch sewer pipe was laid to the sewer. Over the top or opening of this pipe, in the centre of the street, is placed a small catch basin surmounted by a specially made iron grating. The water flowing down the track and along the side of the rails, is thus rapidly removed and a simple and effective drainage secured.

Injury to track by vehicles and heavy teaming.—On our track, which is standard gauge, four feet eight and a half inches wide, heavily loaded vehicles cannot drive along it and get the benefit of the smooth metallic surface as in the case with girder rails. This condition is a great improvement, and makes a saving in many ways.

First. It saves an immense amount of money in repairing the injury and wrenching to track and rapid wear and tear thereto caused by vehicles, and particularly heavily loaded wagons turning in and out and driving along the track.

Second. It permits a quicker and more frequent car service—which all street railway men know means time and money by giving the cars a clear track.

These are great advantages and will be best appreciated by the managers of the lines in large cities. They can also bear testimony to the large savings effected in the wear and tear.

To further prevent heavy teaming along the flange spaces of our track, and at the same time make the wear and tear on the street paving, which we are required to maintain, a minimum, an ordinance was passed by our City Council, October 4, 1892, compelling wagons weighing with their loads between 4,000 and 7,000 pounds to have tires 8 inches wide, and $8\frac{1}{4}$ inches for greater weights. This ordinance took effect in December, 1892.

In closing this report, gentlemen, I wish to thank you for your attention, and at the same time express the hope that it will prove, as it was intended, a good guide to you in securing that very necessary condition for successful and economical operation—*perfect track*.

THE WORKING EXPENSES OF ELECTRIC AND CABLE RAILWAYS.

In our issue of Oct. 17 we printed a number of statistical tables showing the expenses of operation of various electric railways, both here and abroad. The interest attaching to this subject prompts us to reproduce more detailed figures of comparison for a number of electric and cable railways in England, taken from the *English Railway World*, together with the deductions arrived at by that journal:

We may here give a comparison of the expenses and the receipts per ton mile of the various lines which have been considered. We do not attach any great importance to a comparison between the statistics of cost of dragging each ton weight one mile as between the two electric railways and the three tramways. The conditions on the railways are altogether different from those obtaining on the tramways. On the former roads there are no stoppages except at stations at least half-a-mile apart, and above all the unit dealt with is, in comparison with a single tramway car, very large. The proportion of dead weight of train to the weight of the passengers carried is also very much larger in the case of the railways than that of the tramways. We would therefore invite comparison simply between the Liverpool and the London electric railways, and then between the Birmingham electric, the Birmingham cable, and the Edinburgh cable tramways. The Liverpool train when empty weighs about 81 tons, and its seating capacity is for 114 passengers. With full load the weight is therefore about 38 tons. The London train empty also weighs about 81 tons, and with the full complement of 96 people on board, it runs to some 87 tons. The Birmingham accumulator cars, with their batteries in place, scale 8 tons each, and with all the seats occupied by 50 passengers, they reach 11 tons each. Every Birmingham cable car weighs 5 tons when empty, and with 50 passengers 8 tons. In Edinburgh two sizes of cars are used, one weighing 6 tons empty and carrying 56 passengers, and the other scaling 4 tons, and accommodating 40 passengers. The average weight therefore, with all seats occupied, is 8 tons. The following tables are based upon these figures, and go upon the assumption that all seats are always filled. Manifestly this is not the case in reality, but the assumption made is perhaps the best way by which anything like a comparison can be instituted. The real cost per ton mile is doubtless considerably more than given

below, but for purposes of comparison the relation would be the same. It will be noted that though the expenses per ton mile are so low on the railways, the receipts are correspondingly low in comparison with the tramways. The half-yearly blanks in the

EXPENSES PER PASSENGER CARRIED—PENCE.

Year or half-year.	Liverpool Electric.	London Electric.	Birmingham Electric.	Birmingham Cable.	Edinburgh Cable.
June, 1889 ...	...	...	...	78	...
June, 1890 ...	...	...	...	69	76
Dec., 1890 ...	...	...	...	...	77
June, 1891 ...	...	154	123	66	69
Dec., 1891 ...	...	135	...	...	76
June, 1892 ...	...	129	213	67	66
Dec., 1892 ...	...	115	...	...	72
June, 1893 ...	122	114	188	66	61
Dec., 1893 ...	133	116	...	...	63
June, 1894 ...	125	106	182	63	55

RECEIPTS PER PASSENGER CARRIED—PENCE.

Year or half-year.	Liverpool Electric.	London Electric.	Birmingham Electric.	Birmingham Cable.	Edinburgh Cable.
June, 1889 ...	...	...	...	142	...
June, 1890 ...	...	...	...	142	114
Dec., 1890 ...	...	...	...	...	113
June, 1891 ...	...	195	183	128	113
Dec., 1891 ...	...	177	...	...	113
June, 1892 ...	...	184	181	128	112
Dec., 1892 ...	...	169	...	...	113
June, 1893 ...	216	177	184	125	113
Dec., 1893 ...	178	171	...	...	112
June, 1894 ...	168	172	179	129	111

Birmingham columns are explained by the fact that the reports of the company are only issued annually, while the other blanks are antecedent to the dates at which the respective railways and tramways came into operation.

In America some street railway men favor an analysis which

COMPARATIVE EXPENSES PER TON MILE—PENCE.

Year or half-year.	Liverpool Electric.	London Electric.	Birmingham Electric.	Birmingham Cable.	Edinburgh Cable.
June, 1888 ...	...	...	...	122	...
June, 1889 ...	...	...	...	109	...
June, 1890 ...	...	...	...	8	111
Dec., 1890 ...	...	...	...	...	112
June, 1891 ...	...	58	92	82	94
Dec., 1891 ...	...	53	...	...	101
June, 1892 ...	...	52	142	8	82
Dec., 1892 ...	...	47	...	...	69
June, 1893 ...	4	45	153	83	81
Dec., 1893 ...	35	43	...	...	79
June, 1894 ...	35	43	155	75	67

COMPARATIVE RECEIPTS PER TON MILE—PENCE.

Year or half-year.	Liverpool Electric.	London Electric.	Birmingham Electric.	Birmingham Cable.	Edinburgh Cable.
June, 1888 ...	...	...	...	218	...
June, 1889 ...	...	...	...	199	...
June, 1890 ...	...	...	...	164	166
Dec., 1890 ...	...	...	...	...	166
June, 1891 ...	...	73	138	16	183
Dec., 1891 ...	...	7	...	...	151
June, 1892 ...	...	74	12	16	139
Dec., 1892 ...	...	69	...	...	141
June, 1893 ...	72	69	149	159	15
Dec., 1893 ...	48	64	...	...	14
June, 1894 ...	48	69	163	155	136

shows the receipts and expenses per passenger carried. It is of considerable value in some aspects, but for general purposes we do not consider that it is at all equal to the figures for each car mile or train mile run. It depends altogether on how the cars are

filled, while the car mile figure of expenses is to a large extent independent of that condition, especially with cable haulage. However, at considerable labor we have compiled the above tables, which show the expenses per passenger carried, and also the receipts for the various lines dealt with, from the dates they commenced working down to the present time:

The fractions are carried to only two places of decimals, which is sufficient for the purpose. It will be observed that the order of things in the ton-mile tables is now reversed, and that the tramways, apart from the Birmingham electric line, stand lower than the railways. This, of course, arises from the fact that the number of passengers in proportion to the weight of the vehicles is much greater in the case of the street car than in that of the railway carriage. It is also worth remarking that of late the Edinburgh cable line is lowest in the list as to expenses per passenger. The latter circumstance partly arises from the fact that there are two sections of the Edinburgh cable roads, so that the through journeys are short, and partly from the fact that the fares are very low. It should be stated that as regards the expenses per passenger on the Birmingham lines, the extra expenses for salaries and fees before referred to are included, as are also the Corporation charges. It may further be noted that the receipts per passenger in all the columns do not represent the average fare per passenger. The latter sum would be a trifle lower, as the figures in all the tables include the whole of the receipts, which, besides passenger fares, embrace revenue from advertisements and one or two other minute items.

Taking it over all, it will be seen as regards the two electric railways that there is as yet little to choose between them. When the Liverpool line has been running as long as the one in London, it may show better results than the latter now does. It certainly is doing better than the London line did at first, though scarcely so well, from the percentage point of view, as the Metropolitan electric road is now doing. On the other hand the London expenses per train mile are higher than those in Liverpool. In the case of the tramways the unapproached position of the Edinburgh cable line, in view especially of the lightness of the traffic, is plainly manifested.

So far as the figures we have given go, the conclusion will be drawn that in the domain of railways electric traction for short local lines, where the traffic is sufficient, can compete favorably with steam locomotives, while in the case of street tramways it will be difficult to find any method of haulage which, with a fair traffic, can be operated more economically than the cable system.

TO NEWARK, N. J. BY TROLLEY.

"I had occasion the other day," said a citizen, "to go to Newark, and I thought I would go by the trolley. I had never been that way and I had an idea it would be fun; I thought we should go bounding across the Newark meadows like a rocking meteor on wheels. As a matter of fact the trip was made in an entirely smooth and decorous manner, but it was not without interest. I bought passage at a little ticket office which stands on the sidewalk in Cortlandt street against the side of the building on the southeast corner of West street. For ten cents, I received two tickets, one entitling me to a ride over the ferry and the other to a ride on the electric cars from Jersey City to Newark.

"We left New York at 2:31 P. M. We started from Jersey City at 2:42 in a large open car in which there were twenty-six passengers. It is a familiar fact that these cars take only through passengers, but passengers are taken up by out-going cars anywhere on the line in either terminal city, to be set down anywhere on the line in the other. We had one passenger get aboard the car I was on who wished to get down at a point in Jersey City. The conductor, learning this when he came for the fare, explained that it was a through car only, and he got down and waited for another car. We had altogether when we reached the Jersey City limit thirty-seven passengers, having taken up eleven.

"On the inner side of the car, toward the other track, there was a wooden bar extending the length of the car, like that on the Third avenue cable cars, so that passengers could not get on or off on that side. Just before leaving Jersey City to strike across the meadows a corresponding bar on the other side was let down from where it had been held in straps under the roof; then we were ready for the stretch of three or four miles across the meadows.

"The tracks there are ordinary railway tracks, the rails laid on sleepers, and the ways stone-ballasted; they run on either side of the plank road, except on the bridges, where they converge and cross by the highways. The cars run slowly on the bridges; elsewhere on the meadow tracks their way is unimpeded. In Jersey City the motorman had held the car in pretty well on curves and let her go right along on straight stretches. I expected that when we got started on the meadows we should fairly hum, and the motorman did open out at a good lively gait, but we ran along with perfect smoothness and without any incident whatever, though it was all interesting to me because it was new. How fast we went here I don't know—pretty fast; but aside from that, the

great saving of time is made by keeping going. There are two slow-downs for the bridges, but on the other parts of the meadow road, with no passengers to set down or take up, speed can be maintained.

"In Newark the outer rail along the outside of the car was raised again. This car arrived at the Market street station of the Pennsylvania Railroad at 3:24. Time from New York, 53 minutes; time from Jersey City, 42 minutes. Time on the Pennsylvania Railroad by a train scheduled to leave New York at 2:30, from New York to Market street, 86 minutes; from Jersey City, 21 minutes. There are trains that make the distance in less time. I stayed on the car to Broad street and got off there, that being the point nearest where I wanted to go. Arrived at Broad street at 3: 7. Time from Jersey City, 45 minutes, distance from Jersey City about $8\frac{1}{2}$ miles. So that the actual speed of the car was at the rate of about twelve miles an hour.

"My business was quickly dispatched and I was soon back at the corner of Market and Broad streets, the business centre of Newark, and a busy corner it is, too. There at 4:15 P. M. I took a trolley car for New York. We had seventeen passengers on this trip. We reached the trolley car station in Jersey City at 4:59. I got a ferry ticket there and crossed by the Deebrosses Street Ferry, landing on this side at 5:16, pleased with the experience.

LIGHTING AND RAILWAY CONSOLIDATION AT HELENA, MONT.

Another of the new lighting and railway consolidations that are beginning to attract so much attention has just been effected at Helena, Mont., where the Helena Power and Light Co. has absorbed the electric railway, the electric lighting and the gas interests of that city. The new company has a capital of \$1,000,000. The officers are H. M. Parchen, president; T. H. Kleinschmidt, vice-president; H. L. Walker, secretary, and T. A. Marlow, treasurer. The railway plant consists of 16 motor cars and 8 trailers, running over 24 miles of T and girder rail, and operated by a power house with two 250 H. P. and two 175 H. P. Corliss engines. The apparatus is Thomson-Houston and Westinghouse. The lighting plant is Westinghouse and comprises 180 arcs and 5,000 incandescents.

NEW YORK TO CAMDEN BY TROLLEY.

Another electric railway system is knocking for entrance into Camden, and a formal application has been made for the appointment of a committee to confer with the officials of the company with a view of laying out a route. The new system is the New York and Philadelphia Traction Company, which is to erect an electric line from New York to Camden with lines running down from Trenton on both sides of the Delaware. The company is an outgrowth of the Consolidated Traction Company, which is already in possession of trolley lines aggregating 100 miles in operation in the northern part of New Jersey.

TAMPA, FLA., LIGHTING AND RAILWAY COMBINATION.

Mr. R. W. Easley, president of the Tampa and Palmetto Beach Railway Co. writes us that the road has been leased to the Consumers' Electric Light & Street Railway Co. for a term of ten years.

LITERATURE.

Central Station Bookkeeping and Suggested Forms with an Appendix for Street Railways. By Horatio A. Foster. New York. The W. J. Johnston & Co., Ltd. 1894. Cloth. Illus. pp. 189. Price, \$2.50.

About two years ago Mr. Foster prepared for THE ELECTRICAL ENGINEER by request a series of articles, the first of the kind, on central station bookkeeping. They were remarkably well received and were subsequently issued in book-form. The present volume may therefore be regarded as a second edition although the matter has been wholly recast. The book is admirably prepared and does credit alike to author and publisher, but we fear that neither is likely to reap much profit from it. In other words, we have come to the conclusion that central stations for lighting or railway work are not willing to change their methods of accounting, even though an angel from heaven came down with a gratuitous set of ledgers. A new station here and there might be induced to adopt Mr. Foster's really excellent suggestions, but as every going station has a system of its own its managers will be extremely and naturally loath to make a bookkeeping revolution. But though wholesale changes are thus out of the question, Mr. Foster's book abounds in useful blanks, hints, suggestions and remarks, and we can only hope that some readers will follow his expert advice.

MISCELLANEOUS.

THEORY OF THE SYNCHRONOUS MOTOR.¹

BY C. P. STEINMETZ.

THE author gives as the fundamental equation of the synchronous motor: $e_0^2 - e_1^2 - u^2 c^2 - 2rp = 2s \sqrt{c^2 e_1^2 - p^2}$; where e_0 = the impressed E. M. F.; e_1 = the C. E. M. F.; c = the current; p = the power; r = the resistance; s = the reactance; and u = the impedance.

This equation shows, that at given impressed E. M. F. e_0 and given impedance $u = \sqrt{r^2 + s^2}$, three variables are left, e_1 , c , p , of which two are independent. Hence, at given e_0 and u , the current c is not determined by the load p only, but also by the excitation, and thus the same current c can represent widely different loads p , according to the excitation; and with the same load, the current c can be varied within a wide range, by varying the field excitation e_1 .

The author applies his equations by working out a numerical example for a 100 kw. motor supplied from a 2,500 volt generator over a distance of five miles, the line consisting of two wires, No. 2 B. & S. gauge, 18 inches apart. Here $e_0 = 2500$ volts, $r = 10$ ohms, and $s = 20$ ohms including line and motor, and hence $u = 22.36$ ohms. The curves Fig. 1 give the power characteristics for $p = 10, 50, 100, 150$ and 156.25 kw., respectively, together with curves of zero displacement, and of maximum displacement.

The characteristic curves of the synchronous motor as shown

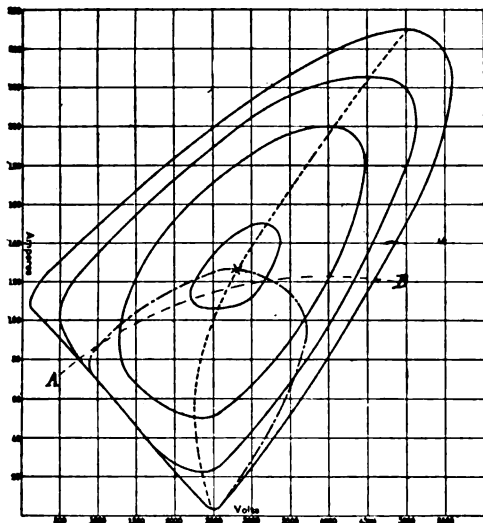


FIG. 1.

in Fig. 1, have been observed frequently by the author, with their essential features, the V-shaped curve of no load, with the point rounded off and the two legs slightly curved, the one concave, the other convex; the increased rounding off and contraction of the curves with increasing load; and the gradual shifting of the point of minimum current with increasing load, first towards lower, then towards higher values of C. E. M. F. e_1 .

The upper parts of the curves, however, the author has never been able to observe experimentally, and considers it as probable, that they correspond to a condition of synchronous motor running, which is unstable. The experimental observations usually extended about over that part of the curves of which lie below the dotted line A B; in trying to extend the curves further to either side, the motor is thrown out of synchronism.

It must be understood, however, that these power characteristics of the synchronous motor in Fig. 1 can be considered as approximations only, since a number of assumptions are made, which are not, or only partly, fulfilled in practice. The foremost of these are:

1. It is assumed that e_1 can be varied unrestrictedly; while in reality the possible increase of e_1 is limited by magnetic saturation. Thus in Fig. 1, at an impressed E. M. F., $e_0 = 2,500$ volts, e_1 rises up to 5,590 volts, which may or may not be beyond that which can be constantly given by the motor.

2. The reactance s is assumed as constant. While the reactance of the line is practically constant, that of the motor is not, but varies more or less with the saturation, decreasing for higher values. This decrease of s increases the current c corresponding to higher values of e_1 , and thereby bends the curves upwards at a lower value of e_1 than represented in Fig. 1.

It must be understood that the motor reactance is not a simple

quantity, but represents the combined effect of self-induction, that is, the M. M. F. induced in the armature conductor by the current flowing therein, and armature reaction, that is, the variation of the C. E. M. F. of the motor by the change of the resultant field, due to the superposition of the M. M. F. of the armature current upon the field excitation.

8. These curves in Fig. 1 represent the conditions of constant electric power of the motor, thus including the mechanical and the magnetic friction (core loss). While the mechanical friction can be considered as approximately constant, the magnetic friction is not, but increases with the magnetic induction, that is with e_1 , and the same holds for the power consumed for field excitation.

Hence the useful mechanical output of the motor will on the same curve $p = \text{const.}$ be larger at points of lower C. E. M. F., e_1 , than at points of higher e_1 , and if the curves are plotted for constant useful mechanical output, the whole system of curves will be shifted somewhat towards lower values of e_1 ; hence the points of maximum output of the motor correspond to a lower E. M. F. also. It is obvious that the true mechanical power characteristics of the synchronous motor can be determined only in the case of the particular conditions of the installation under consideration.

THE THEORY OF TWO AND THREE PHASE MOTORS.¹

BY LIEUT. SAMUEL REBER.

Without attempting a complete mathematical solution the author gives an approximate solution in which the change of magnetic properties of the iron and magnetic leakage are neglected, the coefficients of self-induction considered constant, while the mutual-induction between the armature and field circuits follows a sine law, and the field is supposed to be without projecting pole-pieces.

The conclusions reached by the author are that the two and three-phase motors have in general the same properties and that the most important relation is that of R to fL ; where R the resistance of the resistance of the armature; $f = 2\pi$ times the complete periods of armature circuit; and L equals the coefficient of self-induction of one armature circuit. The lower the field armature resistance is, the higher the efficiency of the armature and the nearer to synchronism is the point of maximum torque. Hence high efficiency motors require a starting resistance, and in such motors the torque can be readily regulated by adjustment of the armature resistance and we are enabled to throw the point of maximum torque at any speed we desire. It is likewise apparent that the smaller the magnetic leakage the more efficient the motor.

If the frequency is supposed to vary, the speed and output are greatly changed. Increasing the frequency n times in a motor without a condenser, the velocity will be increased n times, the maximum torque is not affected, while the hysteresis is increased n times nearly, the output of the motor will be increased nearly n times if the motor is run at a given percentage of the maximum torque. Hence it is an advantage to increase the frequency till the hysteresis heating becomes too great, or the motor runs too fast. If the efficiency is to be kept constant, the work will then vary as n^2 and the field and armature currents will be increased

$\sqrt{n}$ times. Hence increase in speed gives an advantage in output till the machine begins to overheat. With a condenser the same facts hold, but with this advantage that an increase in the frequency greatly reduces the size of condenser necessary. A high frequency motor will weigh less than a low frequency one. When the clearance is large, the advantage of high frequency motors is not so decided, and if very large the low frequency motors are better if weight is no consideration. The higher frequency motor will contain less iron and more copper. If we vary the size of the motor, keeping the magnetization constant, output and hysteresis vary directly as the weight, and the heating of the field and armature circuits, directly as the increase of size.

THE SEARCH LIGHT ON THE "PARIS."

The steamer "Paris" on her arrival at Southampton from New York reported cutting in two a sailing ship, off the Scilly Islands. It was also stated that a long time elapsed before the search light could be turned on the scene of the disaster. The explanation of this has not been forthcoming. The light ought to have been in order for immediate use.

The Treasury Department at Washington is inviting proposals until 2 o'clock, November 10, 1894, for manufacturing and placing in position in complete working order in the United States buildings at Houlton and Lewiston, Maine, Fremont, Neb., and Staunton, Va., combination gas and electric light fixtures. Prospective bidders can obtain additional particulars by addressing the Secretary of the Treasury.

1. Abstract of a paper read before the A. I. E. E., Oct. 17, 1894.

1. Abstract of a paper read before the A. I. E. E., Oct. 17, 1894.

LEGAL NOTES.

RIGHTS OF ELECTRIC COMPANIES OCCUPYING PUBLIC HIGHWAYS.

A decision was handed down by Judge Peckham of the Court of Appeals of the State of New York recently, all the other justices concurring, affirming the judgment of the General Term of the Supreme Court in favor of the plaintiff in the case of Charles Eels against the American Telephone & Telegraph Company. This is a decision of very great importance to telegraph, telephone and other incorporated electric companies in reference to the erection of poles along public highways. It appears that the plaintiff is the owner in fee, subject to the public easement, of certain premises constituting part of a public highway in the town of Alden and county of Erie. The defendant company occupies a portion of the highway with its poles. The plaintiff claims that the defendant has no right to thus occupy any portion of the public highway and accordingly commenced an action of ejectment to recover the premises, subject to the public easement therein for the highway. The statute provides that telegraph corporations may construct lines upon the public roads, streets and highways, in such manner as not to incommode the public, and also upon any other land subject to the right of the owner of the soil to compensation therefor. It has heretofore been held that a telephone company in this respect stands upon the same statutory footing as a telegraph company.

After full consideration of the matter the court holds that the state can neither itself appropriate to its own special, continuous and exclusive use, nor can it authorize a corporation to so appropriate any portion of a rural public highway by setting up poles therein for supporting telegraph or telephone wires; that the question as to the legality of such use is in no wise affected by the fact that the legislature, by statutory enactments, has manifested its belief in the existence of such a right, or by the fact that property-owners have generally acquiesced in such views. When, therefore, a telephone and telegraph company, organized under the laws of the state, without the consent of an adjoining owner who owns the fee of a highway, and without having acquired the right by condemnation proceedings, erects its poles on the highway and strings its wires thereon for the purposes of its business, such use of the highway is unlawful, and an action of ejectment is maintainable against the company.

This decision renders it necessary for a telegraph or telephone company to make some compensation, when demanded, for the value of the use it makes of land outside and beyond the public easement in the highway, but, inasmuch as under the statute, the company has power to take the land upon making compensation, a property owner cannot stop a proposed undertaking by refusing to permit the poles to be set on his land.

LAST OF THE FEEDER AND MAIN CASE.

THE EDISON ELECTRIC LIGHT COMPANY VS. WESTINGHOUSE, CHURCH, KERR & COMPANY.

In the U. S. Circuit Court for the District of New Jersey, at Trenton, October 26, Judge Edward T. Green, in pursuance of the decree of the Circuit Court of Appeals, against the complainant, and on motion of Kerr & Curtis, Solicitors for defendant, ordered that defendant have judgment against the Complainant, the Edison Electric Light Company, for the sum of \$42.65, amount of costs taxed in the U. S. Circuit Court of Appeals, and have execution therefor; also that defendant have judgment against the complainant, the Edison Electric Light Company, for the further sum of \$6,411.57 amount of costs taxed in the Circuit Court, and have execution therefor.

AGAINST THE "HUCKLEBERRY" ROAD.

Judge Ingraham in the New York Supreme Court, Special Term, has held that the extensive building of the "Huckleberry" trolley system in Northern New York city is not justified, and that the section in the act of 1894 favoring it is unconstitutional and void. He leaves it to the appellate court to decide whether the original act of 1868 is sufficient to protect the road.

THE LYNN WORKS.—There are various reports current in Boston as to proposed renewal of work on a large scale at Lynn, by the General Electric Co., and the *Boston Herald* says that much of the plant taken to Schenectady is to be taken back to Lynn. Against these rumors may be set the report of an attempt to transplant part of the work to Elizabeth or Elizabethport, N. J.; and the fact that as the Vanderbilt interests in G. E. are large, it would be a natural thing for the whole plant to stay where it is along the line of the New York Central in the Mohawk Valley. Readers can take their choice.

LETTERS TO THE EDITOR.

DANGER OF THE RULES OF THE UNDERWRITERS' INTERNATIONAL ELECTRIC ASSOCIATION, COVERING THE USE OF 500-VOLT FUSES.

THE writer recently received a pamphlet from the Board of Fire-Underwriters containing a description of a series of tests to determine the safe length of fuses of different capacities in amperes for 500-volt circuits. The deductions from the above tests were formulated as rules of practice for users of 500-volt circuits. The tests were conducted by a committee representative of the several Boards of Fire-Underwriters throughout the United States.

Great care was observed by those conducting the tests in question, and if the practical use of fuses, particularly the conditions under which a fuse "blows" were in any wise similar to the requirements as prescribed, then the tests and results would not be open to criticism; unfortunately the "blowing" of a fuse is an accident, and an accident is an occurrence over which we have no control; it is just as likely for a "short-circuit" to occur on a circuit containing, say, a ten (10) ampere fuse, as it is to have a condition of circuit wherein just the ten amperes, the minimum current required to "blow" the fuse, will flow.

The sole animus for making the tests, was to determine the dimensions of fuse blocks that would overcome the arcing phenomena attendant upon the "blowing" of 500 volt fuses in lower voltage fuse blocks, the only type heretofore available for use. As will be noticed, the tabulated results state specifically the safe lengths in inches for different capacity fuses, ranging in size from 10 amperes to 100 amperes in 10 ampere steps; further, the

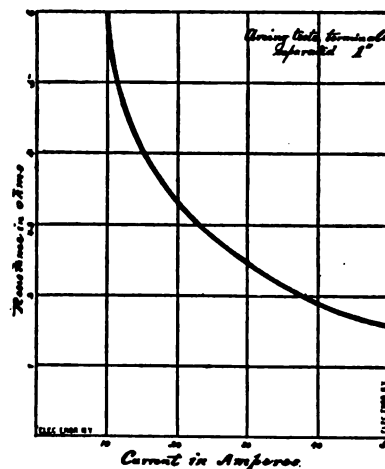


FIG. 1.

results as obtained were based on the one condition that the current in amperes flowing at the time of fusion, was the minimum current causing fusion. In addition to the foregoing, attention is called to the better protection afforded by using a bridge.

The writer intends to demonstrate, by both the results of practice and specially conducted tests, the absurdity of promulgating the results of such incomplete tests as the basis for formulating rules in the matter of the protection of 500 volt circuits.

Since the arc accompanying the "blowing" of a fuse, is the thing to be avoided or rather mitigated, tests were conducted with a view to determining the properties of an arc under the same conditions as regards length, with different currents. Pieces of No. 8 B & S gauge copper wire were cut and mounted horizontally, an inch apart longitudinally. An arc was established between these terminals with 10 amperes; note was taken of the ohmic resistance. Next, 20 amperes was caused to flow, and again note was taken of the ohmic resistance. This process was repeated for currents in 10 ampere steps to 50 amperes, in each instance note being taken of the ohmic resistance.

The curve, Fig. 1, shows graphically the relation borne by current flowing through the arcing interval of one inch, and its corresponding ohmic resistance.

It will be noticed, and to this fact the writer would draw particular attention, that the ohmic resistance drops off very rapidly as the current increases. The results, as obtained, show beyond the peradventure of a doubt, that under conditions of a short-circuit the ohmic resistance of the arc is negligible. The decrease in resistance in the arc as the current increases, is unquestionably due to the greater volume and therefore greater cross-section of the heated gas formed, as it does not seem possible that the specific ohmic resistance of the gases should materially vary. It is interesting here to make note of the fact that

the slightest movement of the air in the vicinity of the arc caused a variation in the resistance.

The foregoing establishes positively that if a given length break in a fuse block protects for one maximum current, it may not for greater currents; the entire and sole cause of the protection afforded in a break caused by fusion, is due directly to the resistance interposed in the circuit by such fusion, and the tests show that such resistance becomes less as the current grows greater.

In order to read the almost instantaneous currents due to short circuits, a magnetic circuit breaker of the C-S automatic type was taken and calibrated to open on different adjustments, ranging from 88 amperes to 400 amperes. Different lengths of No. 80 B & S gauge copper wire were tested in series with the C-S circuit breaker directly across the 500 volt bus bars of the switch-board of the Camden Horse R. R. Co., thus making an absolute short-circuit. In every instance, for each length of the No. 80 B. & S. gauge copper wire, ranging from one inch to eight inches, with and without bridge, upon making a short-circuit the C-S circuit-breaker set for 400 amperes was opened.

Here is an exceedingly interesting state of affairs, a copper wire which will fuse upon the passage of about two amperes allowing 400 amperes to pass upon a short circuit, and then not protecting the circuit in which it was placed, for the magnetic circuit breaker opening was the immediate cause of the breaking of the arc established by the "blowing" of the fuse. This latter deduction is not correct because a No. 80 B & S gauge copper wire will really only permit the passage of 40 amperes upon a 500 volt short circuit.

The question naturally arises: how did 400 amperes come to flow? The answer is readily given in the light of the knowledge we have of the properties of arcing, and is: This excessive current flows not through the fuse but through the arc maintained at the expense of the terminals, the fuse simply playing the role of establishing a condition. In a long series of experiments covering another field of research, but wherein almost innumerable fuses of different capacities and lengths were employed in making 500 volt short-circuits, in no instance was the circuit protected by the fuse, but by the opening of the main magnetic switch-board circuit breakers. In many instances, fuses made of No. 22 B. & S. gauge copper wire 6 inches long, have opened circuit breakers requiring 800 amperes to open.

There exists a popular misconception of the action of bridges. A bridge is an additional protection, as it increases the length of the arc, other dimensions remaining the same, but as we approach short-circuits, the little additional length due to the bridge does not figure, and the repeated tests made by the writer, emphatically confirm this fact. The ideal and not impracticable fuse block for the protection of 500-volt circuits, is not one with a great breaking distance, neither one with a bridge, but one with protected terminals. This type permits the blowing of the fuse only, without the attendant arcing, always vicious and destructive of the terminals.

In conclusion, a 500 volt circuit is not protected by the forms of cut-outs recommended by the International Electric Association; further, it is absolutely dangerous to adopt such precaution as the continued arcing which would ensue in event of a short-circuit, would easily ignite any inflammable material in the immediate vicinity; this latter claim is confirmed by the frequent instances of car and car house fires.

WALTER E. HARRINGTON,
Electrical Engineer.

CAMDEN HORSE R. R. CO., CAMDEN, N. J., Oct. 8, 1894.

THE TRAINING AND EDUCATION OF ELECTRICAL ENGINEERS

Relative to the National School of Electricity and to Correspondence Schools and to your recent editorial on the matter, I am glad of the opportunity to make a few comments.

First.—Who are the men to whom such schools appeal? As a matter of fact, we find that there is no limitation. All ages and conditions as to mental training, practical experience, etc., are represented. Therefore, certain questions arise—on what basis shall the course in the specialty desired be prepared? Shall it be comprehensible to a student not knowing the alphabet of the language, and shall he be taught by object lessons, or shall he be taught the alphabet and the grammar and after thorough drilling in the preliminary studies, then be taught the specialty? There is a great difference between instruction and education. A course may be very instructive, but may fall far short of educating a man fit to be a practitioner, even to the most limited extent.

Second.—Engineering is an exact science. Electrical engineering is not an exception. Therefore, the science of quantities—mathematics—must be known by the engineer and also the knowledge of the laws governing the phenomena. It is also necessary to understand mechanical drawing.

A college training is on the above basis, as is also each course of The Correspondence School of Technology.

Third.—Students not able to afford a college course can only

give a limited time to education and must take advantage of all spare moments. They must have all matters placed before them clearly and systematically. If a point is not understood, they must have the explanation to ponder over. In order to fix the knowledge it must be applied to a number of cases and, in order to be sure that they really know the subject, their work must be criticised.

Fourth.—Nothing less than the above can be considered as an education. The courses of The Correspondence School of Technology educate the student in the manner described. They cannot in the spare moments devoted by a student during from one and a half to four years give the equivalent of a college course, but they can and do furnish students thorough training to the extent promised and which is only secondary, and in some directions, is not below that of a college course.

Fifth.—Lectures of a descriptive character and so prepared as to be understood by a popular audience can be instructive and valuable especially when prepared as are those of the National School of Electricity, but it cannot produce men trained in electrical engineering. The lectures are of great assistance to those hearing them, particularly if they fully use the aids offered them, but the prospective student should understand something of the limitations and not expect impossibilities and when he has completed such a course, he should understand on what plane he stands.

Sixth.—Whatever course of instruction a student takes, and in whatever manner, he should have pointed out its limitations and the fact that when he has completed it he has only made a start in his career as an electrical engineer. If this is true of a college course, it is also true of any other.

The writer has made investigations relative to The National School. He has had experience in college as student and professor. He has given a course of lectures to those unfamiliar with mathematics and science, and is now giving such a course, and is in charge of the work of The Correspondence School of Technology, Cleveland, Ohio, and the above is his belief on the subject and the following is his advice:—

Go to a technical school if you can. If not, take some course of instruction in a systematic manner and do not try to skip the hard work. Understand the limitations of the course before you take it; after commencing, stick to it, and if you are a good man you will never be satisfied with the extent of your knowledge, although, if you work hard under competent instruction, you will be satisfied with the course. If you are satisfied with yourself you can assure yourself that you have much to learn and the sooner you get over your conceit the better.

E. P. ROBERTS.

CLEVELAND, O.

SOCIETY AND CLUB NOTES.

MEETING OF THE NEW YORK ELECTRICAL SOCIETY.

A MEETING of this society took place on Nov. 1 at Columbia College, Mr. Jos. Sachs reading a paper entitled, "Is there a Solution for the Electric Conduit Railroad Problem?" The speaker illustrated his remarks by a large number of lantern slides of various conduit systems in use and proposed. A spirited discussion followed which was participated in by Messrs. Wolcott, Stetson, Fairchild, Lundell and Merrill.

DUTY TO BE PAID ON EDUCATIONAL STORAGE BATTERIES.

Storage batteries imported for educational purposes have been decided by the General Appraisers to be dutiable, because they are more commonly used for practical purposes than in making observations for the furtherance of science. The Armour Institute of Chicago ordered the batteries. The collector at that city levied duty on them as manufactured metal. An appeal was taken on the ground that they were exempt from duty under the provision admitting free philosophical or scientific apparatus for purposes of instruction. The General Appraisers stood by the Collector.

ANOTHER ELECTRIC ROAD FOR SARATOGA.

Frederick B. Barnes, representing the Boston Construction Company, has received from the Trustees of this village a franchise for an electric road from Ballston to the village line. He will deposit \$50,000 as a guarantee that the road will be built and in operation not later than Aug. 1, 1895. This means the first step, toward a network of electric roads in this county. The most important connection will be that of Ballston Spa and Saratoga Springs, which lie seven miles apart. The mineral springs at each place are identical, and it is believed that the construction of the electric railways will make one big watering place of the two towns.

Trade Notes and Novelties AND MECHANICAL DEPARTMENT.

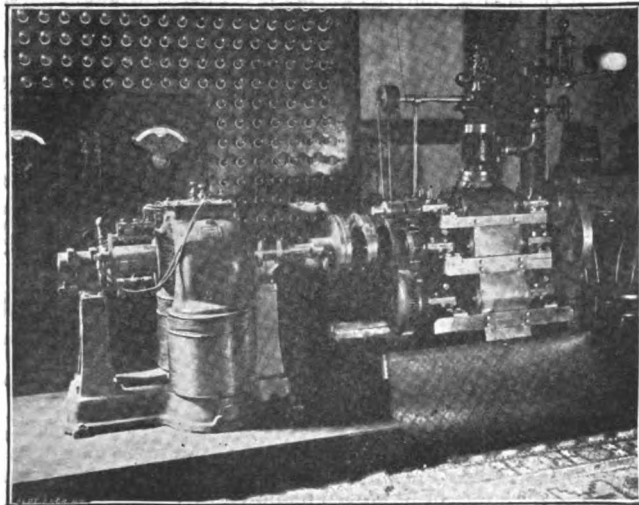
THE MORSE ROTARY ENGINE.

We illustrate in the accompanying engraving the new engine of the Morse Rotary Engine Co. now on exhibition at their office No. 1 Bath St., Boston Mass. This engine is an entirely new departure in its line, and from its high efficiency and economy of operation as well as from the limited space it occupies, will no doubt attain a prominent position.

It is a compound triple expansion engine without other valves than the pistons themselves, each pair of which act as cutoffs for the following cylinder, and the steam is expanded from an initial pressure of 85 pounds down to $2\frac{1}{4}$ pounds exhaust, thus giving very high economy.

In the experimental plant, as shown in our illustration, the engine is direct coupled to a 350 light compound 110 volt LaRoche machine, and occupies a space of only 36 x 41 inches over all and 31 inches in height. The entire floor space occupied by both engine and dynamo is 7ft. 4 in. x 32 inches. The nominal speed is 900 revolutions, and at this speed 50 horse-power is actually transmitted.

One important and valuable feature is, that the same engine can be run from a low pressure heating boiler as a simple engine, or from high pressure boilers, compound; this is particularly de-



THE MORSE ROTARY ENGINE DIRECT COUPLED TO LA ROCHE DYNAMO.

sirable where ventilating fans are to be driven through the day-time by the same engine which is to be used for electric lighting. It is a noiseless, high-speed engine and no foundation is required other than one sufficient to sustain its weight, which, with the small amount of space required, will make it especially valuable to builders of steam launches and small yachts, there being absolutely no vibration.

The engine has been put through a series of the severest comparative tests at the Massachusetts Institute of Technology, in Boston, and by these tests its efficiency was found to be fully equal to the very best types of slow-speed engine, and 40 per cent. better than the best high-speed engine.

A 150 H. P. engine is now being built to order and others will follow, including a gas engine of over 30 H. P. the patterns for which are now coming from the pattern shop. The compression of the gas and air takes place in the first pair of cylinders, the explosion in the second pair and the power is developed in the second and third pairs. There has also just been completed a 10 H. P. engine running at a speed of 1200 revolutions at 80 pounds initial pressure and occupying a space of 13 inches square and 12 inches in height, intended for ventilating purposes.

BROWN & SHARPE MFG. CO.

The Brown & Sharpe Mfg. Co., of Providence, have issued a catalogue illustrated with beautifully executed engravings of some of their stock cutters and others suggesting their facilities for special work. The company now manufacture nineteen varieties and 849 sizes of stock cutters and can make any other size and shape that may be desired. The pamphlet contains no descriptive matter whatever, and certainly requires none.

THE HATCH ELECTRIC HIGH AND LOW WATER INDICATOR.

This is an exceedingly simple device for indicating high and low water in all kinds of steam boilers. It is easily attachable to any boiler and forms a safeguard against carelessness in the boiler-room, and disasters liable to follow the lack of sufficient water or the introduction of too much water into the boiler.

A hollow copper float within the glass rises and falls with the water in the boiler. When the water drops to the danger line, the float drops until it rests on the points of two copper wires, making an electric connection with battery and causing a bell to ring until the water again raises the float from the points of contact. In case of too much water in the boiler the float is crowded upward against two contacts at the top wires, causing the bell to ring until the water lowers and allows the float to drop away from points of contact. The float and also the points of the connecting wires are plated with platinum to prevent corrosion.

The device is manufactured by Riley & Hatch, of Hartford, Conn., for whom E. L. Bradley, of $7\frac{1}{2}$ Austin street, Newark, N. J., is agent.

HUBLEY ELECTRIC RAILWAY MATERIAL.

The Hubley Manufacturing Company, of Lancaster, Pa., and 79 Chambers street, New York City, have issued a neat, attractive and convenient catalogue of railway material, profusely illustrated and containing a good deal of interesting matter, in addition to "business." The company have exceptional facilities for manufacturing all kinds of electrical appliances and make a specialty of railway and lighting supplies.

HIMMER DRY APPARATUS.

Mr. Vitalis Himmer, long and favorably known from his connection with Himmer & Anderson has, since the dissolution of that firm, continued the manufacture of his dry batteries at 182 Fulton street. The numerous and large orders recently received have had the effect of keeping all hands hard at work, besides furnishing additional testimonials of the merits of Mr. Himmer's apparatus.

NEW ENGLAND NOTES.

MIDDLETOWN, CONN.—Mr. E. W. Goss, superintendent of construction of the Middletown Horse Railroad Co., writes us that the equipment for the trolley system will be one M. P. 90 and "G. E. 800" motors with K controllers. The overhead equipment will be that of the New York Electrical Works.

THE MATHER ELECTRIC COMPANY, of Manchester, Conn., report the closing of a second contract with the Hartford and West Hartford Horse Railway Company, Hartford, Conn. for two of their 180 K. W. railway generators with new Mather station equipment, the first generator, which was installed a few weeks ago, having given such perfect satisfaction.

MR. J. E. TALBOT, late of Boston, has accepted a position with the Linton & Southwick Manufacturing Co., of Worcester, manufacturers of all kinds of switches for electric light and railway work. Mr. Talbot was for years associated with the Fort Wayne Co., and is well known to electrical engineers all over the country, and should prove a valuable acquisition to the Linton & Southwick Co.

THE FORT WAYNE ELECTRIC CORPORATION, through their New England agency, of which Mr. E. I. Garfield is manager, have recently sold three 500 light alternating current dynamos for central station work, and expect in a few days to secure orders for two arc light machines which are wanted to replace those of other manufacture. Mr. Garfield has gathered around him some able salesmen, and is now thoroughly equipped for business, having one of the most attractive looking offices in the East, fitted with first class samples of the goods he intends selling.

THOMPSON-BROWN ELECTRIC CO., of Boston, whose formation was recently noted in these columns, gave an interesting house-warming entertainment to their friends on the afternoon and evening of Oct. 25. The store was nicely decorated and well lit up by incandescent lamps and in the window was displayed a very pretty model of the Statue of Liberty, surmounted by a small incandescent light. In the private office, the actual gold Victor Key, by which President Cleveland set the Machinery in motion at the World's Fair in Chicago last year, was shown and it attracted a great deal of interest. About 250 friends from all over New England, the provinces, New York and elsewhere, responded to the invitation to be present on the occasion, and enjoyed the hospitality of the Thompson-Brown Co., a beautiful cold collation being set out in the office, and large and flowing punch bowls and numerous boxes of cigars also being provided for those who desired that form of refreshment. In the evening a musical programme was presented, and in spite of the very stormy nature of the weather, many of their friends lingered till

late in the evening, enjoying themselves with joke and jest, and occasionally entertained by speeches from the more fluent and reminiscent of the gentlemen present. A happy and satisfactory evening was spent, and now the Thompson-Brown Co. have seriously entered upon their career as an electrical supply house, and are ready for all the business with which their friends may favor them.

THE BIDDLE ELECTRIC CAR LIGHTING SYSTEM.

The accompanying illustration shows the Biddle system of electric lighting for railway cars, as applied to an ordinary passenger coach. The system is automatic and simple, has very few parts and, as each car is complete in itself, will operate anywhere. The apparatus consists of a dynamo carried upon the truck and geared directly to the axle and flexibly supported by means of a special device, patents for which are still pending. A spur gear on the axle meshes into a pinion on the armature shaft and can be geared to suit any speed from five to ninety miles an hour. The dynamo is governed for variable speeds by the use of a compound winding in which the series and shunt coils are in opposition. Current is carried from the generator to the switch-board where are placed the necessary instruments for regulating the direction of the current according to that of the train and for automatically cutting in and out a battery of accumulators at the proper moment.

The generator is self oiling and is provided with carbon brushes. Everything is water and dust proof. The car shown is fitted with 18 lamps of 16 candle power at 24 volts and the accumulators have a capacity of four hours with full load. Mr.

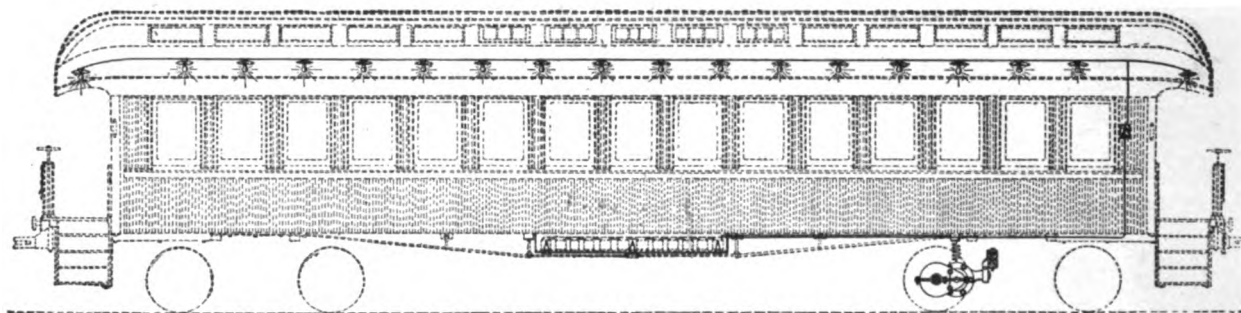
pany of Waterford and William Yeardon of Fort Plain, and two machines are to go to a large apartment house in Chicago.

BERLIN IRON BRIDGE CO. The new power station for The Nassau Electric Railway Co., at Brooklyn, N. Y., will be 100 ft. wide and 150 ft. long, and will be constructed entirely of iron and steel, the whole designed and built by The Berlin Iron Bridge Co., of East Berlin, Conn. The roof will be covered with their well-known patent anti-condensation corrugated iron roof covering. Randolph & Clowes, of Waterbury, Conn., have placed the contract for the extension to their muffie room with the Berlin Iron Bridge Co.

PHILADELPHIA NOTES.

MR. JAMES G. BIDDLE and **MR. W. BIDDLE, Jr.**, announce that they have ceased to hold the positions of joint managers of the physical and electrical departments of Queen & Co. The former gentleman also announces that he will be glad to hear from prospective purchasers of scientific apparatus, at 119 South Fourth street, Room 28, Philadelphia. Mr. Biddle was for five years manager of the Queen sales department and has an intimate acquaintance with apparatus.

THE UNITED ELECTRIC IMPROVEMENT CO. have removed their office and works to the Warden Power Building, 19th street and Allegheny avenue, Philadelphia. The location is convenient to Germantown Junction on the Pennsylvania Railroad and Tioga Station on the Philadelphia and Reading Railroad, and can be reached by the 18th and 15th street trolley lines. The company's increased facilities will enable them to carry in stock for prompt delivery alternating current generators, direct current apparatus



CAR EQUIPPED WITH THE BIDDLE ELECTRIC CAR LIGHTING SYSTEM.

Biddle is of the opinion that the electric lighting of railway trains has now been so simplified that it should entirely supplant both oil and gas.

The offices of the Biddle Railway Car Electric Lighting Co. are in the Downing Building, 108 Fulton street, New York city.

NEW YORK NOTES.

MR. A. A. CARY, M. E., of the Abendroth & Root Mfg. Co. has recovered from his late serious illness and is once more in his old haunts, hard at work, all the better, if anything, for the remarkably severe ordeal he has been through.

FIRE WIRES UNDERGROUND.—The Board of Fire Commissioners have awarded the contract to put underground the wires of the department below One Hundred and Thirtieth street to the Standard Underground Cable Company, for \$28,959.51. The work must be done in 100 days.

BROOKLYN TROLLEYS.—Oliver W. Ingersoll of Bergen street, Brooklyn, has applied in the Supreme Court before Justice Pratt, for a temporary injunction restraining the Nassau Electric Railway Company from constructing its road on Bergen street, as it has not obtained the consent of the property owners. Decision was reserved.

NEW UTRECHT, N. Y.—The New-Utrecht Hygiene Ice and Manufacturing Company has been formed to manufacture and deal in artificial and natural ice, electrical and gas appliances, and lamps in the Thirtieth Ward of Brooklyn; capital, \$235,000; Directors, Harry W. Hatch, Hector M. Hitchings, Albert E. Lazzaro, Frank Muehlfeld, and William A. Powell of New York City.

THE E. G. BERNARD CO., of Troy, N. Y., reports a revival of business, which causes it to be about two weeks behind on its orders. The company has just finished equipping the residences of Levi P. Morton and John Jacob Astor at Rhinecliff with electrical apparatus. It is also shipping a complete plant to Lord & Taylor for their Broadway store, New York. Contracts have been closed with Huyck & Sons of Albany, Ormsley Textile Com-

pany for lighting and transmission of power, and improved long distance series incandescent apparatus; also a full assortment of series incandescent lamps of improved manufacture.

WESTERN NOTES.

THE STAR ELECTRIC LAMP COMPANY, Chicago, has changed its name to the Sunbeam Lamp Mfg. Co.

THE NATIONAL ELECTRIC REMINDER COMPANY has a capital stock of \$250,000; incorporators, Sigfried Rosenfeld, Augustus Binswanger and David C. Thomas.

THE NORWOOD PARK Electric & Construction Co. will use for its conductors the Simpson combined curb and conduit system, in which vitrified tile is used.

THE CENTRAL ELECTRIC COMPANY, after having made exhaustive and careful tests of the B. & S. compounds and paints, will handle this product in the West, as General Western Agents. They report that they find that the B. & S. products are the highest insulating mediums of their kind on the market, and state that they will carry a large stock in their Chicago warehouse, and have already secured sufficient orders to prove that the trade appreciates the superiority of this product.

"MACHINE TOOLS" is the name of a pretty little polyglot pamphlet issued by the alert and vigorous Niles Tool Works Co., of Hamilton, O., in which many of their admirable tools for electric light and railway factories, stations, power houses and repair shops are illustrated and described. It is an epitome of Liebig's extract of their sumptuous large catalogue.

Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.

Vol. XVIII.

NOVEMBER 14, 1894.

No. 341.

AN ISOLATED STORAGE BATTERY PLANT,
MONTREAL, CAN.

BY

L. M. Piolet

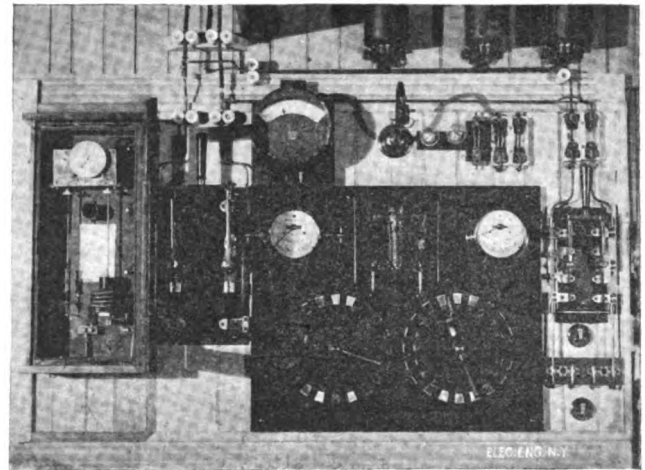
THOUGH there has been much discussion recently upon the advantages of storage batteries as auxiliaries to the dynamos in central electric light stations, but little attention has been given to the use of the batteries for the same purpose in small isolated electric light plants. The batteries are well adapted for this service and in a number of cases would be even more advantageous than in a large lighting station. In many isolated plants, the dynamos and their driving engines are in charge of attendants who also have other duties to perform, such as looking after other machinery. Under these conditions the cost of operating the electric plant is small; but if lights are needed after the regular working hours, the cost is great, because then the other machinery is shut down and attendants must be provided for the electric plant alone. Where a small number of lights are required, this cost is usually so great as to preclude the running of the electric plant after the regular hours, and current must be obtained from some electric light company or recourse be had to gas. In such a case, a storage battery of sufficient capacity to carry the load after the regular hours of running, would be very economical and advantageous. As the battery would require but little attention, it could be taken care of by the regular attendants without extra help and could be charged during the time when the dynamos and other machinery were running. The expense of its operation would thus be practically only the trifling cost of the extra coal burned to supply the power to the steam engine which drives the dynamo for charging the battery. Taking into account also the interest on the money invested in the battery plant and the expense of its maintenance, the cost of operating the battery would in nearly every case be considerably less than the cost of electricity or gas obtained from some outside company.

A model installation of this kind and one that will serve to illustrate the peculiar advantages of storage batteries in isolated electric plants, is the battery installation in the large dry goods store of Henry Morgan & Co., at Montreal, Canada. The electric light plant is located in the basement of the store, and its equipment consists of two 50-light T-H arc dynamos, one 250 light 110 volt, compound-wound Thomson incandescent dynamo and a 50 ampere, 140 volt, shunt-wound, Crompton dynamo for charging the storage battery. Power is supplied by two high-speed engines of 80 and 40 H. P., the larger one being belted to the two arc dynamos and the smaller one to the incandescent and Crompton dynamos. Three Babcock & Wilcox boilers of a total capacity of 125 H. P. furnish steam to the engines and also to steam pumps.

The storage battery consists of 60 Crompton-Howell cells, manufactured by the Crompton-Howell Electrical Storage Company, of London, England. The plates of the battery are of porous lead obtained by casting molten

lead, when at the point of crystallization, into blocks composed of lead crystals held together at their points of contact. Plates of suitable size for the batteries, are sawn from the blocks and are so porous that almost every crystal in them is bathed freely by the electrolyte in the cell. The innumerable surfaces of the crystals in the plates are formed by the Planté process into active material which adheres very firmly to the crystals and, being interlocked in the spaces between them, cannot fall off to any serious degree. The batteries are thus able to stand very hard use without injury and have a high capacity and efficiency owing to the large surface of the crystals in the plates, which is exposed to the electrolyte.

The battery is located in a small room built expressly for the purpose near the dynamo room. Each cell rests on a separate tray supported by insulators filled with oil and contains 10 positive and 11 negative plates. Glass vessels 13 in. by 17 in. in size, contain the plates which rest on



STORAGE BATTERY SWITCHBOARD.

celluloid combs on the bottoms of the vessels and are separated from each other by glass separators. The battery has a capacity of 450 ampere-hours at a discharge rate of 40 amperes, but can be discharged at the rate of 200 amperes and is thus able to carry the entire load for a short time in case of the stoppage of the incandescent dynamo.

The switchboard for the storage battery installation is shown in the accompanying engraving and is so arranged that 19 cells at the negative end of the battery serve as regulating cells. The negative terminal of each regulating cell is connected in regular order to a contact in each of two circular battery switches. The switch on the right is used for discharging and that on the left for charging, and, as explained, their contacts are interconnected. When the double-throw switch to the right of the board is on its lower contacts, the arm of the charging switch is connected thereby with the negative terminal of the dynamo for charging the battery and the positive pole of the battery is at the same time connected with the positive terminal

of the dynamo. With the arm on the end contact of the switch, as shown in the engraving, the charging current from the dynamo goes through all the 60 cells; but if the arm be moved to the next contact, the last cell at the negative end of the battery is cut out and the charging takes place through 59 cells. The cells are cut out of or cut into the circuit one after the other by moving the switch arm in one direction or the other, and any number of the regulating cells can thus be cut out when charging the battery.

When the double-throw switch is on its top contacts, the battery is cut off from the charging dynamo and is connected with the store lighting circuit to carry the entire load. Or, if there is an overload, the battery can be discharged in parallel with the incandescent dynamo. With the switch on the top contacts, the negative pole of the battery is connected with one side of the lighting circuit through the circular discharging switch, and the positive pole is connected directly with the other side of the lighting circuit. As the voltage of the 60 cells of the battery is greater than the 110 volts needed for the lighting circuit, it is necessary to cut out, by the discharging switch, a sufficient number of the regulating cells to bring the voltage down to the desired pressure. In the engraving, the arm of the discharging switch is on the fifth contact from the end; therefore, 5 cells are cut out and the battery is discharging through 55 cells. The five cells serve as reserve cells to maintain the voltage of the battery near the end of its discharge, but are seldom employed for this purpose as 55 cells are usually sufficient to maintain the voltage.

The greatest number of cells ever put into the discharge circuit at the same time is 57, though the rate of discharge has been as high as 75 amperes when the total discharge from the battery amounted to 300 ampere-hours. An important feature of the installation is that current at 110 volts can be obtained from the charging circuit for a small number of lights while the battery is being charged at a higher voltage. In order to prevent short-circuiting the cells of the battery when the arms of the circular battery switches are moved from one contact to another, each arm is provided with a pilot brush in circuit with a resistance.

At the upper corner of the switchboard, are a voltmeter and an ammeter for the battery, and over one of the corners is a Weston station ammeter for measuring the current in the lighting circuit. Near the centre of the board, is an automatic cut-out which automatically completes the circuit between the battery and the charging dynamo when the voltage of the dynamo reaches the right point for charging and breaks the circuit if the voltage of the dynamo falls below this point. Thus the battery current is prevented from flowing back through the dynamo during charging. At the extreme left of the board, is an Aron clock meter of a special construction, which records in ampere-hours the current put into the battery during charge and also indicates the current withdrawn during discharge. A simple contrivance automatically compensates the readings of the meter for the current wasted in the battery during charge and discharge, an allowance of 10 per cent. being made for this purpose, so that the available charge in the battery at any time is accurately indicated.

The arc dynamos furnish current to arc lamps for lighting the main parts of the store, which are only needed when the store is open, and thus the arc plant has practically nothing to do with the storage battery and incandescent installations. The load on the incandescent circuit, consists of incandescent lamps in the show windows, offices, workrooms and other parts of the building, besides 6 arc lamps for lighting the basement during the day time. Motors for operating cash carriers, sewing machines and ventilating fans are also run off this circuit. After the regular hours, when the store is closed, considerable current is used for lighting the drug department, which is kept open at night, and the windows, as well as to furnish light for sweeping and cleaning the store.

It is obvious that the expense of running the incandescent dynamo after the regular hours to supply current to these lamps would be greater than the cost of obtaining the current from a local electric light company. For this reason, before the installation of the storage battery, current was obtained from a local company after regular hours and the incandescent lighting plant was shut down. The cost of the current so obtained amounted to considerable, as an average of 350 ampere-hours was required each night during the fall and winter and a slightly less amount during the spring and summer. This expense led to a consideration of the merits of storage batteries, and, after a careful investigation of the subject, the Crompton-Howell plant described above was purchased and was installed about ten months ago. Since then the battery has run continuously without mishap and has given great satisfaction both as to convenience and economy of operation. It not only carries the night load, but during the spring and summer also carries the day load up to 10 or 11 a. m. Before the installation of the battery, the engine and incandescent dynamo were started at 7 a. m. during this period of the year and ran for the greater part of the day at about one-tenth their normal capacity. At present, the incandescent and charging dynamos are only started when the discharge from the battery is 400 ampere-hours and are run till the store is closed, the surplus power of the engine being used to charge the battery. A good load is thus kept on the engine so that it runs efficiently instead of running, as formerly, very inefficiently for the greater part of the day owing to the extremely small load.

During the winter, when the nights are long, the charging and incandescent dynamos are started at 7 a. m., but as the exhaust steam of the engine is used for heating the building, the extra steam used by the engine for charging the battery is inappreciable. Records of the coal consumed, show that no more coal is burned with the battery in operation than before. The entire expense of operating the battery, consists therefore of the interest on the cost of the plant and the allowance for maintenance, which latter the makers guarantee not to exceed 5 per cent.

As to the care required by the battery, it is important to state that the plant was installed and operated without difficulty from the brief directions of the makers. The battery is inspected once a week to ascertain the condition of the plates and to guard against short-circuits. The specific gravity of the electrolyte in each cell is also taken at the same time with a hydrometer and if not found at the right point is at once corrected. Since its installation the battery has discharged upwards of 60,000 ampere-hours, and not one of its 1,200 plates has given out. With the exception of three or four plates which were slightly buckled in the first charge, the plates appear to be in as good condition as when the cells were first set up.

In concluding, the writer desires to acknowledge his indebtedness to Mr. J. McMurtrie, the electrician in charge of the installation, for information concerning the plant.

THE BEAUTIES OF GOVERNMENT TELEGRAPHY.

During the discussion of the telegraph estimates before the French budget committee, M. Maurice Faure denounced the practice of communicating private despatches to Government departments, and argued that this should only be done in the case of messages of interest to the State. According to the *Paris Temps* extraordinary abuses exist. It declares that telegraphic clerks frequently divulge messages to their acquaintances, so that a whole village is informed of the contents of a despatch even before it reaches the recipient. Prefects, moreover, make copies of all messages, and "in Paris the duplicates sent to the Ministry of the Interior afford much amusement to the clerks." Expensive special despatches from distant countries, according to this authority, have been communicated to other newspapers on friendly terms with telegraph clerks. It is also declared that in Paris every despatch addressed to or sent by any prominent man is communicated to the President and six or seven of the ministers. As an example of the way in which things are done, it is pointed out that during the crisis of 1877 the *Paris newspapers* quoted a despatch which was sent to the *London Times* by its special correspondent but never published.

THE PERRINE SCALE FOR WIRING CALCULATIONS.

THE resistance in any circuit is directly proportional to the volts lost in the same and inversely proportional to the current carried, or,

$$R = \frac{E}{c} \dots\dots\dots 1$$

Graphically this may be expressed by laying off E and L along the axis of Y , and c and d^2 along the axis of X choosing L , E and c , arbitrarily and d^2 so as to satisfy the equation

$$d^2 = \frac{L \times A}{\frac{E}{c}}$$

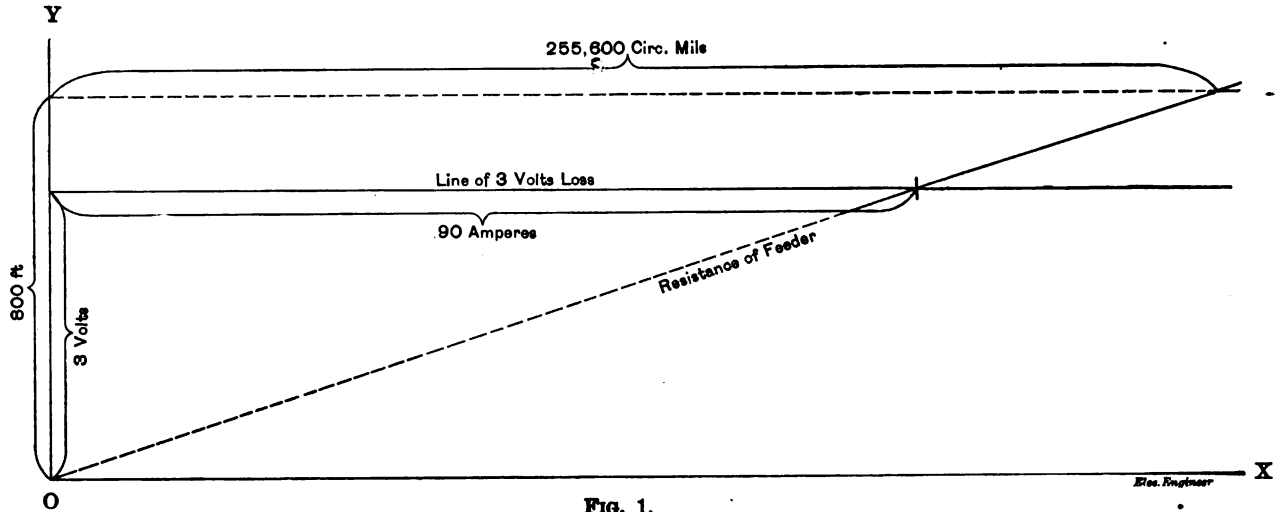


FIG. 1.

Also the resistance is directly proportional to the length of the circuit and inversely proportional to the area of the wire, or,

$$R = \frac{L \times A}{d^2}, \dots\dots\dots 2$$

Then diagonals drawn through the origin will represent lines of constant resistance common to the two pairs of coordinates E and c , and L and d^2 , and to find the size of wire necessary to carry any current a given distance at a known loss of electromotive force it is necessary to find

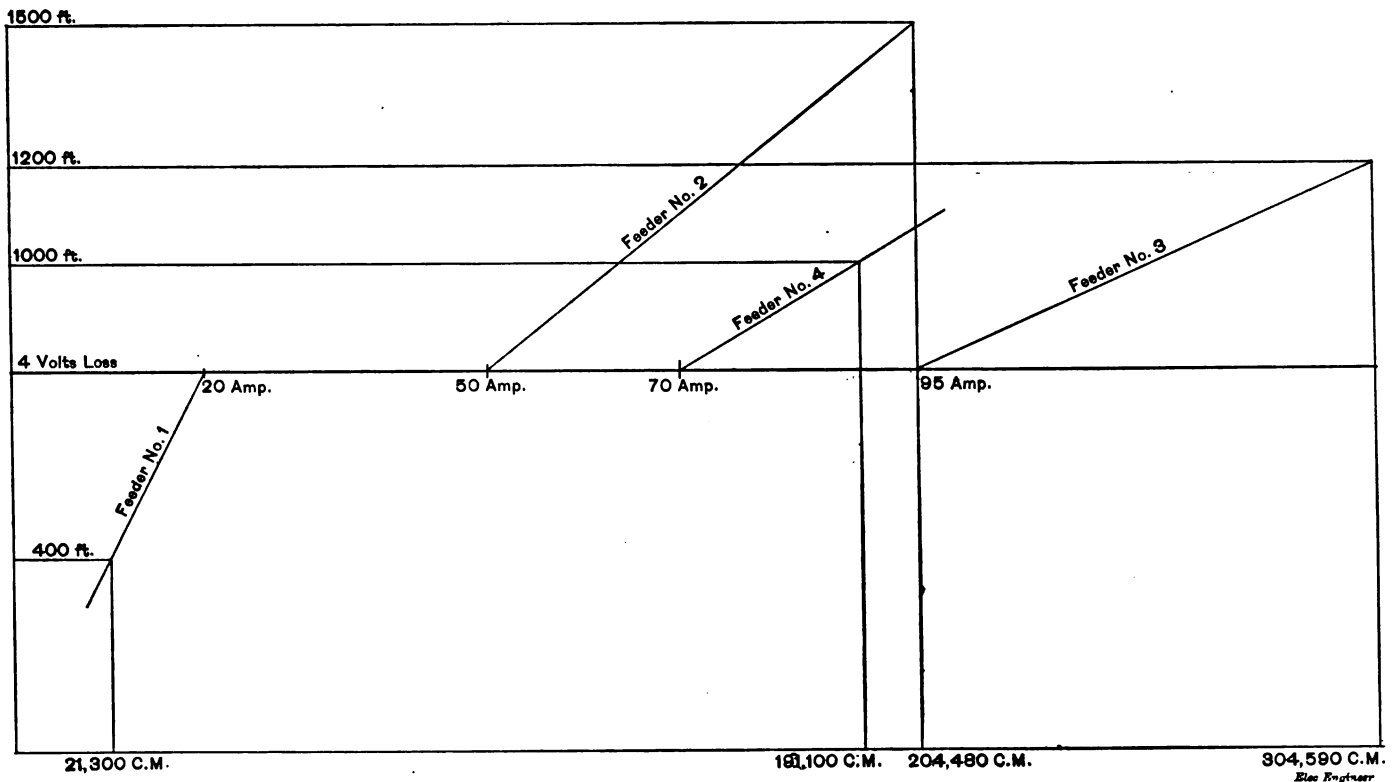


FIG. 2.

where A is a constant depending on the material of the conductor; L the length of the circuit and d the diameter of the wire.

Equating 1 and 2 we have

$$\frac{E}{c} = \frac{L \times A}{d^2} \text{ and } d^2 = \frac{L \times A}{R} = \frac{L \times A}{\frac{E}{c}}$$

or $E : c :: L \times A : d^2$

the point determined by E and c and through it draw a diagonal and where this diagonal intersects an abscissa from the point representing the given distance; the length of that abscissa will give the area of the wire in circular mils or d^2 . Dr. F. A. C. Perrine has calculated three scales for use in this manner. Scale No. 1 is for average currents and distances. Scale No. 2 is for high electromotive forces. Scale No. 3 is for small currents at short distances

The diagram Fig. 1 represents the general method of using Scale No. 1 in the solution of the problem what sized wire will carry 90 Amperes 800 feet at 3 volts loss.

The diagram Fig. 2 represents the application of Scale No. 1 to plotting a number of feeders all at 4 volts loss, and represents the general method of procedure with these scales.

Draw any rectangular coördinates on any plane sheet of paper; from the origin take on the axis of Y a point corresponding to the loss in volts allowable. Draw through this point a line parallel to the axis of X. This line is common to all currents.

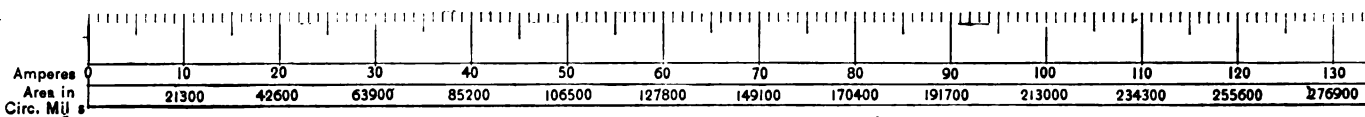
On this line from the axis of Y lay off distances corresponding to the currents and through the points so determined draw diagonals through the origin, O. These diagonals represent the resistances of the various circuits and where they intersect abscissæ from the points corresponding to the lengths of the circuits the areas are determined.

These three scales may be made as separate flat scales,

but many more drills are broken in copper, just because knowledge is lacking.

The usual way of drilling commutator segments, is to grind the drill as if to cut brass, then put it into the ordinary drill press, and pull on the feed lever until the hole is finished or the drill breaks—often the latter. The great trouble is, the drill is forced too far into the copper, and takes too big a chip. Indeed, just before breaking, drills seem to almost run into the work with the pitch of their twist. A break is certain when a drill starts to do this. The remedy is to keep the drill very sharp, and grind it to a slightly less bevel or "rake," so that it will not have so great a tendency to dig into the work.

Another frequent cause of drill breaking when working copper, is in the speed at which the drill is driven. Hardly any of the regular drill presses run fast enough to drill copper with a $\frac{3}{8}$, or a $\frac{1}{4}$ inch drill. Such a tool should be driven from 2,500 to 3,000 revolutions per minute. It should be very sharp, and ground precisely as if for



Scale No. 1

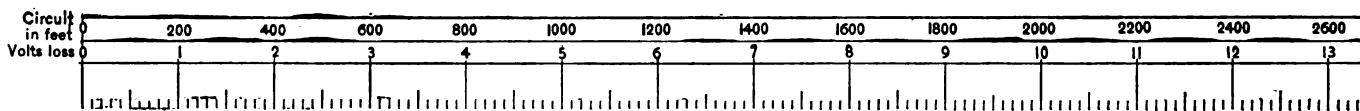


FIG. 3.—PERRINE SCALE FOR WIRING CALCULATIONS.

or as the three sides of a triangular scale; the former method is preferable, as in that case lines may be added of the B & S sizes and carrying capacities of the wires.

Fig. 3 shows a section of scale No. 1.

ELECTRICAL MACHINIST PRACTICE.—IX.

BY

James F. Hobart,

ONE of the vital points of generator and motor construction is the connection of the armature winding and commutator segments. Many schemes have been proposed, tried and abandoned, until general practice in this direction has reduced itself to three methods and, possibly, a few modifications of one of these methods. The three alluded to are:—Soldering, set screws and a combination of the two. Commutator segments must then be either drilled, slotted, or both. Slotting is quite easy with a milling tool, but when drilling is resorted to, there is apt to be trouble. Copper is difficult to drill, and the soft, pure electrolytic copper so often found in commutator segments, is much worse to drill than ordinary sheet, or "hard drawn" copper. A good deal has been said at one time or another, about hardened and tempered copper for commutator segments, but as I find in electrical factories the very purest and softest copper available being made into commutators, I have concluded that it is of no use to expect that hard copper segments will be adopted simply because they drill and tap better than soft ones. Drilling commutator segments is, in a good many shops, attended by broken drills and a good deal of profanity. There is no need of breaking a drill in copper, any more than there is in cast iron,

drilling cast iron. Such a combination will send a drill through the softest copper with a speed that must be seen to be appreciated. In ordinary drilling, a thick, heavy chip comes up which nearly or quite fills the twist cavity of the drill. When drilling at the high speed above mentioned, the chip comes up thin, smooth and even. It is not as unwieldy as the slow speed chip, consequently not so apt to bind in the drill, causing it to break. Neither is the drill, when running at high speed with a small chip, so liable to "dig in" under a thicker layer of copper than it can possibly cut off. When this happens, the drill must stop short or break off, and as it cannot do the former, unless a very sensitive drill is used, breaking is the only resource.

A very convenient drilling arrangement for commutators is in use by a motor company in this vicinity, and the machinist operating the device told me he had not broken a drill for many weeks, the apparatus being in constant, although not continuous, use. The machine in question consists of a semi-portable bench drill, something after the Scott pattern. It is screwed to the bench, and the drill spindle revolved by a horizontal shaft at the top of the stand. An adjustable table serves to locate the work under the vertical drill spindle, which is fed down by a hand lever, and is geared to the horizontal shaft already mentioned. A small motor is belted directly to the horizontal shaft by equal pulleys. The motor is connected directly to the incandescent light circuit by means of a snap switch. No rheostat or other similar devices are used for starting, and within seemingly a dozen revolutions after the switch has been closed, the motor and drill are humming away at 3,000 revolutions per minute.

The drill feeds readily into the softest copper without trouble and with very little effort on the part of the operator. A single thin long chip comes up beside the drill and the hole is finished before it would be well started by the old slow speed method. The running of a

drill by separate motor is not the only application of electricity I noticed in the shops of the company mentioned. A rag wheel was driven by belt directly from another motor, but about fifty times as large as the drill motor. Another motor was belted to the blower which supplied air to the smith's forge. This motor was a small one and different from either of the others, and still another, and totally different looking, motor was driving another machine. I was told that the different motors thus employed, were old cast off machines, some types having been supplanted by other forms. In fact, they were "scrap heap" motors. "But," it was stated, the speaker pointing to the forge motor, "it is wonderful how these old machines will run without even being looked after. I don't know when that motor was oiled last, or when anything was done to it except to start and stop it. It stands there month after month and costs nothing for repairs, yet it is always ready for work." If a machine shop can be thus economically operated with out-cast "scrap-heap" electric motors, how much better would be the service, and cheaper the cost, if improved high efficiency motors were used.

One motor in particular, attracted my attention in this shop. It was driving a magneto for testing purposes. While I do not advocate testing by magneto and bell, still a good deal of it is done, and probably will be for all time, therefore it is in order to do the best we can with that

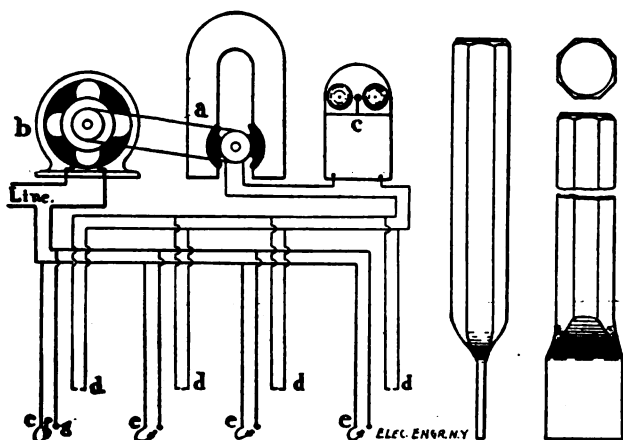


FIG. 85.

FIG. 86.

instrument when forced to use it. As frequently employed, for testing, two men are necessary for its operation and much time is lost in carrying the magneto, waiting for others to get through with it, etc. In these shops, a magneto is permanently located in the winding room, driven by a motor as stated, and wired all around the room. Not only are testing branches taken off every few feet, but a plug for starting the magneto is placed conveniently at every testing station. Fig. 35 shows the wire connections, both for starting the magneto and for testing. But as only a diagram is given, the engraving does not show how the motor, magneto and bell are located on a high shelf out of the way, or how the starting plugs, instead of being put up back of the work benches, at arms length, are handily inserted in the front edge, or top of the bench itself, so that no time may be lost in connecting up to start. The magneto is shown at *a*, the motor at *b*, and the polarized bell at *c*. Testing stations are located at *d, d, d*, and corresponding starting plugs at *e, e, e*. When it is desired to make a test, the magneto may be started at any test station by putting the plug *f* into the socket *g*, completing the motor circuit. This may be done at any of the *e* stations, of which as many as desired may be arranged. Testing is then done by simply connecting the wires *d* with the object to be tested.

It sometimes happens that a polarized bell is not at hand, and it would be a convenience to be able to use an ordinary bell with a magneto. This can be done by

screwing down the contact spring so that the circuit is not broken when the bell hammer strikes the gong. Then, by turning the magneto rather slowly, the bell will respond by a single stroke at each half revolution of the magneto armature. A very low resistance bell might not respond, but any ordinary form used with three or four cells of Leclanché battery in series, will do so unless the screwing down of the contact spring so stiffens the main bell spring that the armature sticks to the magnet cores. When such a thing happens, unscrew the contact spring and make connection around it by means of a bit of wire so that the circuit may remain unbroken at all times. Sometimes the hammer of a bell is too heavy to allow the armature to respond to the magneto impulses. Such bells make excellent buzzers by simply removing the hammer, and allowing the armature to buzz.

A very handy commutator tool is illustrated in Fig. 36. It is intended for removing armature wires from their soldered connections in commutator segments. Soldered connections may be removed by heating with a piece of hot copper, and then digging out the wires with a crooked tool made for that purpose. But in many cases the soldered connections may be driven out bodily with the tool shown in the engraving. It is made of tool steel, and finished up to fit very snugly into the slots in the commutator. Ordinarily, two or three taps of a two pound hammer will start the wires out bodily, all surrounded with their covering of solder. I cannot say how good the connection may be which yields thus readily to being driven out, but I can say that not a dozen connections in a dozen well-known street railway motors refuse to be driven out in this manner, and driven out easily at that.

Some makers of dynamos and motors are evidently not satisfied with either the soldered, or the set-screw connection, for they use both, as stated at the beginning of this article. In support of this double fastening, the makers claim, and perhaps on very good grounds, that while a soldered commutator connection is theoretically perfect, it is liable to become unsoldered by overheating, and throw out by centrifugal force. The set-screw fastening, they claim, is good as long as it is tight, but under the influence of a heavy current, expansion of the metal may loosen the electrical contact of screw, wire and segment. When this takes place, heating at that point is sure to be caused by the increased resistance of a loose contact, perhaps destroying the connection by burning it out. But where both solder and set screw are used, it is claimed that a good connection is maintained under all conditions. In case of heating sufficient to fuse the solder, the form of slot is such that the wire cannot be thrown out by centrifugal force, neither can all the melted solder escape; therefore, if the set screws become loosened by expansion, enough melted solder remains to maintain a good contact until the commutator becomes cool again. This looks reasonable, and is given for what it is worth.

ELECTRICAL UTILIZATION OF THE FALLS OF THE GREAT KANAWHA.

The Great Kanawha Falls Water Power, Electrical, Manufacturing & Land Co. has been formed at Charleston, W. Va., with a capital of \$2,000,000, to build an electrical plant at the Great Kanawha Falls which are to be utilized and their power transmitted to mines, factories and railroads within a radius of 20 or 30 miles. It is proposed also to furnish towns with street and commercial lighting, and to place trolley wires over the channel of the river for the use of tow-boats conveying coal from the mines. The principal stockholders are Charles M. Reed, of Baltimore, Md.; A. McClintock, of Philadelphia, and A. O. Patton, W. W. Tompkins, W. F. Scott, T. F. Snyder, and M. Levi, of Charleston.

THE LARGEST CAR HOUSE IN THE WORLD.

The Metropolitan Traction Co., of this city, is to spend one million dollars on the largest car house in the world, to be erected on Seventh avenue, from Fiftieth to Fifty-first street.

RECENT SPRAGUE ELECTRIC ELEVATOR INSTALLATIONS.

The detailed description of the Sprague electric elevators installed in the Postal Telegraph Building in New York, which appeared in our issue of April 18, 1894, will still be fresh in the minds of our readers. Since then a number of these machines have been erected in other buildings and

A recent test showing the flexibility of the ways of handling a machine of this type was made as follows: The car was stopped, slung by its ropes, one set of sheaves and one of the hoisting ropes taken off, the screw coupling, brake wheel and thrust bearing removed, the nut dislocated, the machine inspected and put together again and into operation in 46 minutes.

Another Sprague elevator, installed in McCoy Hall, Johns

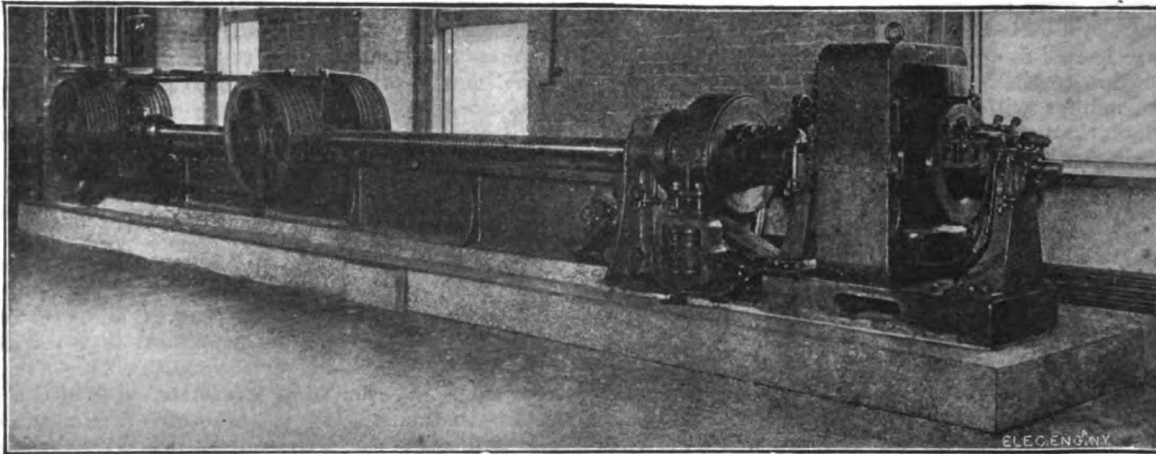


FIG. 1.—SPRAGUE ELECTRIC ELEVATOR, NEW EDISON STATION, ELM ST., NEW YORK.

embodying special features. Among them is the machine installed in the magnificent new Elm St. station of the Edison Electric Illuminating Co., New York, and illustrated in Fig. 1. This is a 12-gear machine, having $1\frac{1}{4}$ " pitch screw, with a regular ball nut and independent regulator. It is unique in that it is probably the only horizontal multiplying machine of any type which is placed anywhere except in the basement or cellar of a

Hopkins University, Baltimore, consists of a pair of machines of the standard type, but geared only 6 to 1. The cars are of about 40 sq. ft. area, and the machines can lift a live load of at least 4,000 pounds. The machines have a modified type of regulator, which is shown in Fig. 2. They are situated in the basement of McCoy Hall and are supplied by current whose potential varies very considerably, and from a station about a mile and a quarter away.

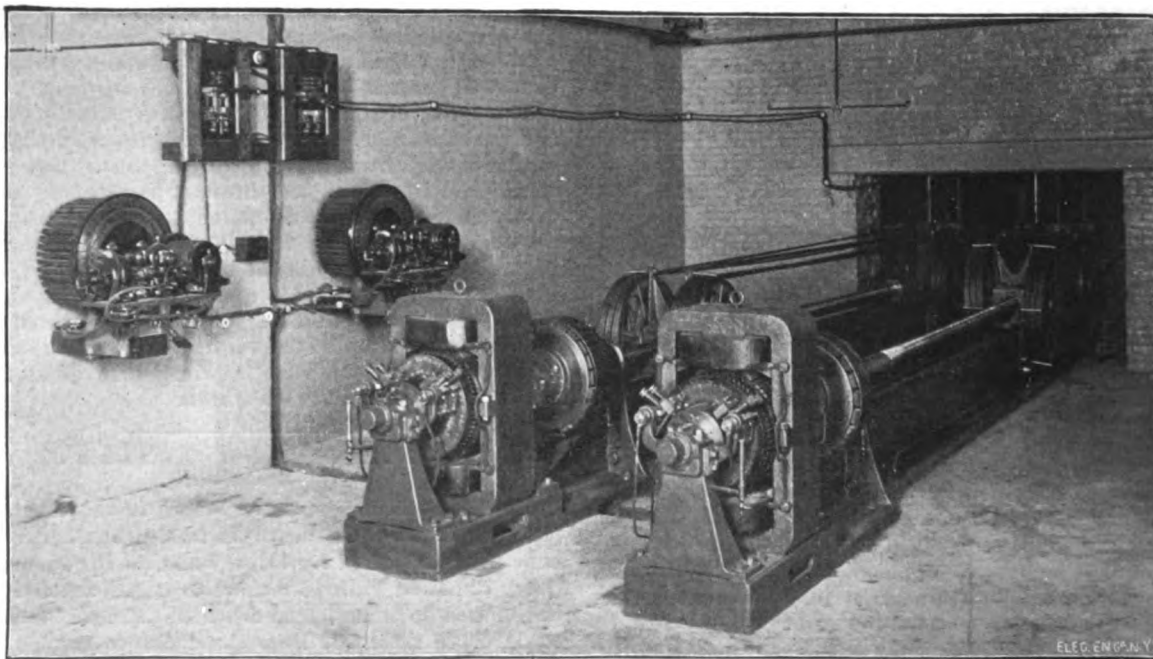


FIG. 2.—SPRAGUE ELECTRIC ELEVATOR, MCCOY HALL, JOHNS HOPKINS UNIVERSITY, BALTIMORE.

building. In this particular case it is placed on the third floor, and the ropes are carried through the side of the hoistway. The machine has a capacity to lift 1800 pounds, and can run at 525 feet a minute. It is the only passenger elevator in the new station of the Edison Company, and is in practically constant service all day long. It was put in place and into operation in one week.

The installation of these machines, which was coincident with those in the Merchants National Bank, of Baltimore, illustrates certain possibilities. The multiplying machines, weighing nearly 12 tons, were delivered at McCoy Hall Thursday afternoon; on Sunday afternoon both were put into operation, and on Monday, one week after shipment, both were used at the opening reception of the Hall-

THE SEWAGE DESTRUCTOR ELECTRIC LIGHT PLANT AT EALING, ENGLAND.¹

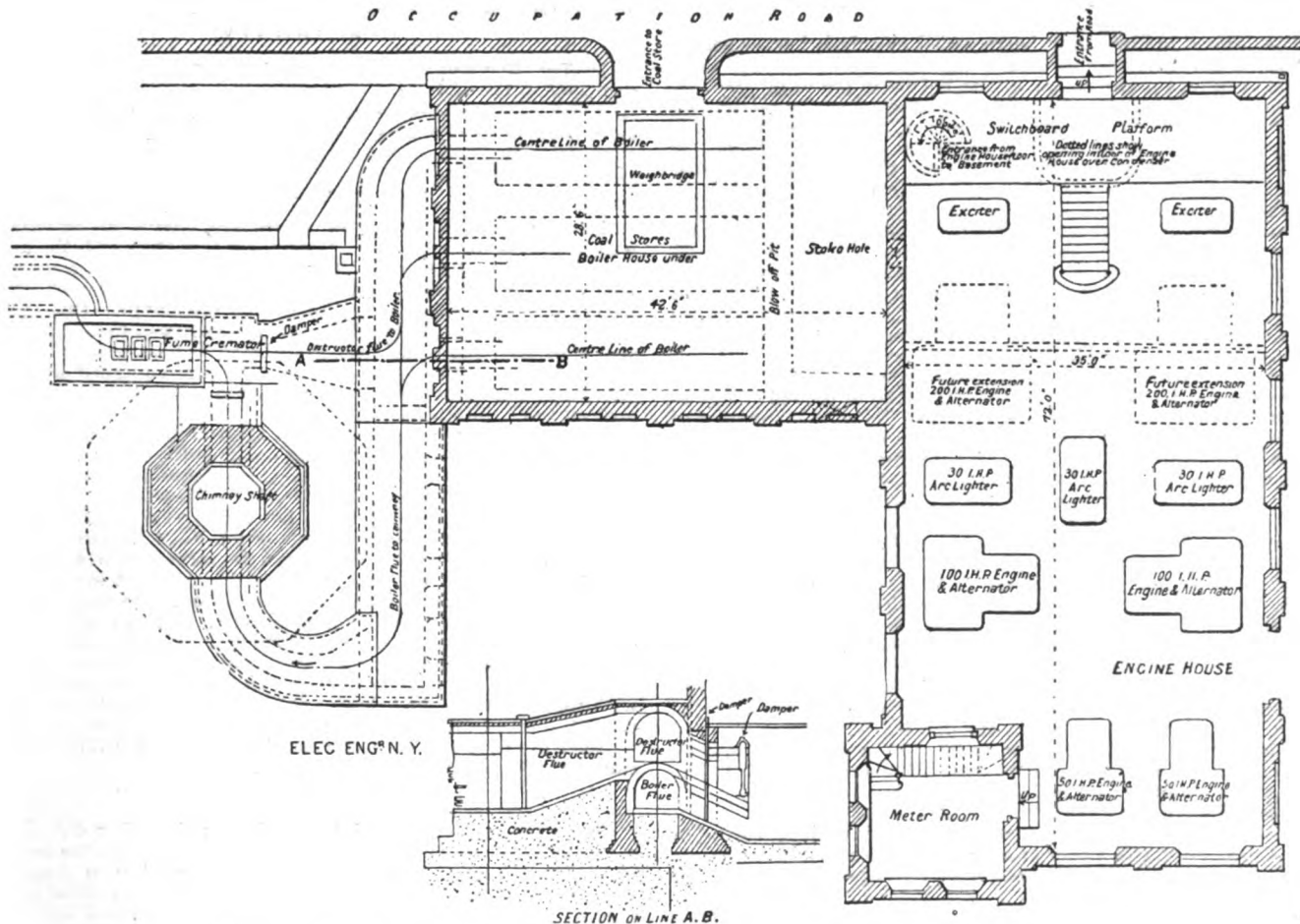
In the electricity works of Ealing a striking and novel departure has been made from existing practice in central-station work, namely, the combined utilization of the waste heat from refuse destructors and the sewage effluent for steam condensing purposes. The destructor cells in which this refuse is consumed are of the Fryer type, made by Messrs. Manlove, Alliott & Co., of Nottingham. This seven-cell destructor deals with about 24 tons of refuse daily, in addition to the sewage sludge arising from a population of some 28,000 persons.

The Fryer cells at Ealing have been constructed side by side, although they can be built back to back, according to local circumstances. Each cell forms a separate furnace, comprising a cavity enclosed by a reverberatory arch lined with firebrick. The cell is provided with a hearth for the reception of the refuse to be burned, from which it passes into the furnace proper. The passage of the material to the front is facilitated by arranging the firebars in an inclined position, which also renders easy the removal of the clinkers. The top of the destructor constitutes a

building and path-making purposes, hard core for roads, artificial stone when ground up as sand, and for the construction of walls. Thus the clinker forms a valuable by-product. The whole of the concrete and mortar used in the erection of the buildings of the lighting station has been made from this clinker, either used whole or ground up into sand.

An automatic arrangement has been adopted for the purpose of maintaining as constant as possible the high temperature in the dust-chamber during the operations of feeding and clinkering. This is accomplished by means of a cast-iron hinged door which is placed over the opening leading into the dust-chamber, and is attached by a chain to the furnace door. The arrangement is such that when the furnace door is open the entrance to the dust-chamber has about four-fifths of its area closed, whilst when the furnace door is shut the flue door is open. As already stated, this method is entirely automatic, and the admission of cold air during the operations in question is reduced as much as possible, when the desired result of keeping up the high temperature which is essential for the proper working of the destructor is obtained.

The difficulty arising from the emission into the atmosphere of the gases and vapors from the destructor cells arose partly from



PLAN OF THE SEWAGE DESTRUCTOR ELECTRIC LIGHT PLANT AT EALING, ENGLAND.

platform, an opening over each cell being provided for the reception of the mixture of sewage sludge and ashbin refuse, which is shot through the opening from small trucks. The opening for the admission of refuse is divided from that for the exit of gases, the division being formed by a wall, whilst a bridge is provided to prevent the refuse heaped on at each charge from getting into the flue immediately below. Special openings are provided for the direct introduction upon the burning mass of infectious mattresses, diseased meat, dead cats and dogs, etc. The furnaces, when once lighted, are kept at work by the refuse itself. In order to prevent inconvenience to the stokers through the fine dust being blown about, a concave pit is constructed under the furnace bars. This pit is partly filled with water, and the fine dust falling therein is removed when the fires are drawn. The clinkering is done at intervals of about two hours, and the quantities of clinker and fine ash vary in proportion to the kind of material burned. The average dust at Ealing is about 25 per cent., a good hard clinker, suitable for a variety of purposes, forming the residuum. This clinker is used in the manufacture of concrete, for tar paving, for

the expulsion of the gases at too low a temperature, and partly from the vapors given off in the drying of the material in the first stage of burning. The idea occurred to Mr. Jones, the engineer of the local board, that by the employment of an additional and independent furnace—arranged between the destructor and the chimney shaft, and in which a very high temperature prevailed—the difficulty could be overcome by passing the gases through it, and thence into the atmosphere, practically innocuous. To this additional furnace Mr. Jones gave the name of the "fume-cremator."

The fume cremator consists of a reverberatory arch with rings of firebricks placed in the direction of the gases. Ribs of firebricks projecting from the arch serve to deflect the gases and direct them on to the top of a red-hot mass of fire. This furnace is fired with coke breeze alone, or coke breeze and ashes screened from the refuse, and an intense heat, calculated at between 1,200 deg. F. and 1,800 deg. F., is maintained at little expense for fuel, a supply of air being provided below the fire-bars and a further supply to feed the vapors as they pass into the cremator. The passing over this bed of incandescent coke at this high temperature practically completes the partial distillation commenced in the destructor cells of the gases, vapors, and fine dust, and what

1. Abstract from the London *Electrical Engineer*.

then enters the atmosphere through the chimney shaft is odorless. Between the cremator and the shaft is arranged a multitubular boiler, in which steam is raised by the hot gases for the purpose of driving an engine and motor mill in the sewage disposal works.

With the establishment of the electric light works this arrangement undergoes certain alterations. In the first place, the existing cremator and chimney shaft will fall into disuse; and in the second, the whole of the waste gases from the destructor cells will be passed through another cremator of the same type, and utilized for steam-raising purpose in the boilers laid down for operating the engines and dynamos. As will be seen from the general plan, etc., of the works, the gases from the main flue of the destructor pass through a damper into a horizontal brick flue a distance of some 80 feet, where they are led over the burning mass forming the furnace of the new cremator. The complete distillation of the gases and vapor being practically accomplished by the fierce heat prevailing in this furnace, the odorless gases, now at a temperature ranging between 1,200 and 1,800 deg. F., are dealt with in either of two ways: they are either allowed to escape from the cremator flue into the chimney shaft through the damper shown in the plan at the base of the shaft, or the damper is closed and the gases pass into the flue from the destructor and thence round the boilers.

The former method may be regarded as only being necessary in case it becomes essential or desirable at any time for some reason or other to raise steam in the boilers in the usual way, as, for instance, when the destructor is shut down annually for about a fortnight for repairs. It must not be inferred from this statement that it is intended to generate steam in all the boilers by means of hot gases, but rather that any boiler or any combination of the three can be made to produce steam in this manner as occasion may arise. As a matter of fact, when the additional destructor cell (the eighth) has been erected, it is expected that the total power obtainable continuously from the eight cells and cremator will amount to about 50 i. h. p., or, say, sufficient to satisfy the day load for some years to come. Thus the utilization of the waste gases from the destructor is really an adjunct to the steam plant, which in itself is quite independent of the refuse destructor when such independence is necessary.

It will be observed from the cross-section of the flue from the destructor (or, rather from the cremator) and of the boiler flue to the chimney, that these pass back around the outside rear end of the boiler-house, and that the flue from the destructor surmounts the boiler flue to the chimney. The admission of the hot gases from the flue from the destructor to the boiler flues and the exit of the smoke and gases from the main boiler flue to the chimney are controlled by a double damper, which is arranged on the inner side of the rear end of the boiler-house wall. When this damper is raised, the gases pass round the boiler flues and underneath into the main boiler flue to the chimney. At the same time the hinged ashpit dampers fitted to the cast-iron fire-door frames in front of the boilers, in addition to ordinary closed fire-doors, are closed so that the fronts of the flues are sealed up airtight, whilst the waste heat alone is being utilized.

When the double damper is lowered, the connection between the boiler and the flue from the destructor is closed, and the boiler is ready for steaming in the usual way. The raising and lowering of the double damper is effected by means of leading pulleys, chains and counterweights. The counterweights are arranged in front of the boilers, so that the double damper may be operated from the stokehole.

Further, as will be seen, the arrangement is such that hand or mechanical stoking of either or all of the boilers can be carried on simultaneously with the utilization of the waste heat from the destructors.

The three boilers are of the Lancashire type, constructed for a working pressure of 120 pounds. They are each 26 feet long by 7 feet in diameter, and are made of mild steel.

Above the boiler house is a coal store capable of holding 100 tons of fuel, shoots being left in the floor so as to feed the hoppers of the mechanical stokers direct. The store is on a level with the road.

The three engines for public lighting are of the vertical compound condensing type, having cylinders 6in. and 10in., and a stroke of 8in. The generators to which these engines are direct coupled are Siemens H H D 32/13 dynamos, each giving 10 amperes at 1,800 volts for working a circuit of 40 arc lamps in series. This type of machine has a ring armature revolving in a double magnetic field circuit, and is provided with a regulator which automatically varies the voltage in proportion to variations in the external resistance, and thus maintains the current constant.

The condensing plant is installed in the basement of the engine house. The arrangement is compact, the air and circulating pumps, which are double acting, being supported on the condenser, and driven direct by a prolongation of the piston rods of the engines. The plant comprises a general surface condenser, to which is connected the main exhaust-pipe receiving the whole of the exhaust steam from the engines. This condenser and its pumps deal with the exhaust steam, not only from all the engines, but also with that from its own steam-pumps, which

are vertical and direct acting. The cooling water for this condenser, which consists of the sewage effluent from the sewage settling tanks, circulates through the tubes, the steam playing outside them. The condenser has a cast-iron case, and is fitted with solid-drawn tinned Muntz metal tubes $\frac{1}{2}$ in. diameter of bore 17 B.W.G. thick, secured in planed gun-metal plates. The area of the cooling surface afforded by the tubes, measured on their external face, is 1,500 superficial feet. The circulating pump suction and delivery pipes are connected to the sumps in the effluent outfall passing through the works.

The arc lamps in the sewage and electricity stations are fed from the direct current of the exciters, whilst the incandescent lamps are on the alternating-current circuit, thus minimizing the probability of all lights being out in the station in case of breakdown of any machine. There will eventually be at least six transformer stations, but at present only five have been provided. At these stations the 2,000-volt current is transformed down to 102 volts. The total capacity of the station is 5,000 8 c. p. incandescent lamps, and the indications are that these will soon be taken up.

THE COMPETITION OF WELSBACH BURNERS WITH ELECTRICITY.

IN THE ELECTRICAL ENGINEER of Oct. 31, the subject of the competition between the electric light and the Welsbach incandescent gas burners was discussed editorially. Since that time we have been in receipt of a number of interesting communications on the subject from central station managers, who have given the matter attention or who have had to experience more or less active competition. Some of these remarks are appended.

In common with many others we are having an experience with the Welsbach burner. I must confess that with the introduction of this burner in its present shape, I felt somewhat annoyed. When new, the brilliant white cone of the Welsbach burner certainly appeals to the eye of the public. One of our customers (a druggist) lured by its brilliancy and fortifying himself with the statement that the excessive heat evolved would help him out with his heating this winter, equipped his store about a month ago. He now mourns the two dollars invested in each burner. From the brilliant white of a few days' duration, the light dwindles to a ghastly, greenish, billious gleam. The druggist, with several others who have paid for their experience in the shape of first installation, hood and chimney renewals, and an unsatisfactory light, is now ready to treat with us for the return to incandescent lighting. Let any one stand thirty or fifty feet away from two stores (side by side), No. 1 illuminated with Welsbach burners which have been in service two weeks, and No. 2 lighted with an equivalent of incandescent lamps. The Welsbach immediately attracts his attention. He sees comparatively large burners emitting a ghastly, greenish white light. Objects within the store are shrouded in gloom and are seen indistinctly. No. 2 apparently exists in a clear cool atmosphere, every object within being clearly seen. The above facts coupled with those given in the columns of THE ELECTRICAL ENGINEER, of Oct. 31, and an effort on the part of electric light people to keep up their lamps to the highest possible standard, should in a short time set aside the Welsbach as a rival.

Since the conversation I had with you the other day on the subject I have been looking around town to ascertain the number of Welsbach burners that are being put in. I told you that there were about 125. That was the count up to that time, but at present I think there must be in the neighborhood of 750. Yesterday we had four customers leave,—two arc and two incandescent,—and they have filled their stores with these burners. It is done mainly on account of the cheapness that presents itself. They are being introduced here at a cost of \$2.50 per burner, with the guarantee of keeping them in order for six months, which I presume, means the renewal of the mantles. I find quite a number of them going in where only two or three are used in a place, superseding the old method of burning gas, and in some instances, the incandescent light. I do not think the question which you raise in your editorial as to the noxious influence is going to weigh very heavily or will be appreciated by the consumer. From experience I find that patrons are willing to accept the baneful condition of the atmosphere as against the saving that will come to them. When I presented it yesterday to a man and gave him in a general way the injurious effects, and stated my own experience in the use of them in my house some years ago by the use of natural gas, I was met with the reply that it made no difference how bad the atmosphere was, they could open the doors and let in fresh air as they wanted to. They were after a cheap light, and believed they had got a better light than incandescent light at quarter the cost. Here, where we have natural gas, it is connected on to the main service lines of a house on the basis of twenty-five cents a thousand cubic feet. This, you see, makes the lighting per month for practically nothing. The illuminating gas companies, as well as the fuel gas

companies, are not favoring this burner, but they are powerless to prohibit anything that customers may put upon their burners. Experiments at the Gas Co. showed that these burners consumed less than one-half what a five foot burner would.

I do not look with very much concern upon it. It is one of the things that come to us periodically, and here I am quite sure that it will not prevail, as it is being discountenanced by those that it would look to for the most encouragement, the gas companies. I may note the statement of a well-known expert that when an increased pressure is put upon the lines incident to the holiday trade the filaments will be consumed. From actual experience I know that the aging of them is very rapid. All these arguments and statements go for naught with the people we have here who lie awake nights finding a way to get something for nothing.

The portion of your editorial which referred to the good policy in efficiency of lamps is timely. It is a matter that we have looked after carefully, and, I think, intelligently. We found that the plan adopted by very many electric light stations was to consent to, if not encourage people to buy lamps wherever they could. This resulted with us in finding installed all kinds of lamps without regard to voltage, and a constant complaint upon the part of our customers that our current was no good. We have adopted the plan of selling lamps to our patrons at twenty cents each. This has righted the abuse.

We have a man who is looking after the Welsbach matter, and from time to time I will let you know to what extent they are adding the burners. The Welsbach people have recently opened a store, and are canvassing the city, more particularly the business portion of the town, and from present indications, I think that they are doing a good business.

When I was in New Orleans the Welsbach burner was making some headway, the first month of its use. A number of the clubs in the city adopted its use to the exclusion of electricity. The renewals of the prepared cone are a great drawback, as each renewal means 50 cents to the consumer. In the cities where the people have to buy the renewal lamps for 50 cents, they do not mind paying for the prepared cone renewals at that price, for the consumption of gas is reduced and they get a better illumination at a less expenditure of money for gas. In cities where the electric company furnishes renewals, it will not make so much difference, as customers would rather pay a little more for light than pay for the renewals of the Welsbach. The life of these cones is only 700 hours.

I have read your article of Oct. 31 in regard to the Welsbach burners. There are something over 2,000 of them in use here. We do not fear them, and I cannot see that it has made any difference in the use of incandescent lights. I agree with your article in regard to the use of incandescent lamps. When they are discolored, I believe in taking them out and in keeping our customers satisfied.

In regard to the Welsbach burner, I would say that it has not as yet assumed such proportion that we consider it a competitor in our business. Of my own knowledge, and from all the information that I have been able to obtain in the matter, we have lost very few, if even a single customer on account of it.

We have a few Welsbach burners in use here, but they have not injured us thus far and they do not seem to increase rapidly. We note that the light is very white when the burner is new, but after a couple of months it assumes a weird, greenish glare better calculated for a spectacular drama than for the prosaic illumination of every day life. We use high efficiency lamps and replace them when they become blackened.

PUNISHING THE HARRISBURG SUBURBS.

It appears that some of the suburban districts of Harrisburg, Pa., have lately declined to be annexed. To make the punishment fit the crime, it has been ordered by the Harrisburg city council that tin shade shall be put on each arc lamp in such a way as to intercept the light on the side toward the suburbs.

HACKENSACK, N. J., EDISON PLANT BURNED.

The Edison electric light plant, owned by the General Electric Co. was completely destroyed by fire on Nov. 6. The fire is thought to have started in the stable adjoining the plant. The damage to the plant will amount to \$30,000, which is covered by insurance. Supt. Davidson thinks the Company will rebuild at once. The town was lighted with electricity, and will consequently be in darkness for some little time.

LETTERS TO THE EDITOR.

PREVENTION OF FLY WHEEL ACCIDENTS.

The frequent recurrence of fly wheel accidents has again attracted attention. Although various anti-bursting fly wheels have been devised of more or less practicability, in which it is attempted to take care of the increased strain caused by the racing of the engine and tending to burst the wheel, by far the best preventive for such accidents is to keep an active watch and shut off the engine at the first indication of racing and every possible means should be provided to facilitate and expedite this operation. It is therefore most astonishing to note the element of danger that exists in nearly all modern stationary engines caused by the relative location of the fly wheel and the throttle valve.

Whether caused by necessity or otherwise, it is certainly peculiar that the handle of the valve is always on the same side of the engine as the fly wheel. Considering that an engine has started to race and the engineer having noticed the fact rushes to the valve to shut off steam, it will readily be seen that his position, in a direct line with the wheel, is not to be envied and that the heroic discharge of his duty may cost him his life.

It seems strange that some means are not provided so that the engine can be stopped at the merest indication of racing and without making it necessary for the engineer to jeopardize his life. This is certainly the function which the governor is intended to perform if it were infallible; but from the fact that it is not, other additional means are necessary.

Various plans have been devised whereby the throttle valve is closed automatically at any great increase of speed. These devices generally consist of an electrical or mechanical motor connected to the valve and which is thrown into action by a small centrifugal or other speed governing device. However, it has been argued that there exists an element of unreliability in such a method.

Various methods have also been invented by means of which the engine can be manually shut down from various parts of the engine room. It would appear to be quite easy to provide a simple and positive device for this purpose which would certainly prove of great value in nearly all engine rooms and which would cost very little and not interfere in any way with the regular working. The valve could, for instance, be operated by a small electric motor which could be actuated by switches located at various points; or a small steam or other mechanical engine could be used and set into action by a suitable mechanical or electrical release. An arrangement of this kind would not only expedite the shutting down of the engine but would also obviate the necessity of having the engineer risk his life.

J. S.

New York, Nov. 5, 1894.

STORAGE BATTERY FOES AND FRIENDS.

I have noted in several of your recent issues, that the storage battery men of the country seem to be rather at "logger-heads" over the question of the merits of their respective batteries, and strive, apparently, to get as much free advertising under the head of "Letters to the Editor," as it is possible to do. It would seem to one interested in the advancement of the art, that these gentlemen might devote their time with vastly better advantage to intelligent experimental work, with a view of providing something practical in the way of accumulators. When one manufacturer goes to the limit of describing the faults he has found in other makes of cells, when put through unknown processes of treatment and test in his own factory, it is hardly a fair opinion to publish, even though no names are given, for anyone in the business can certainly recognize the various types described. Then when another manufacturer goes into print to the extent of a column and a half of your valuable paper, to decry the decision of an eminent Committee representing probably the best known Institute in the country,—simply, apparently, because his battery was not given an award, it would appear even more forcibly that there is a great deal of misdirected energy shown by these gentlemen, which might well be devoted to the object previously stated, namely: some improvement in the cells they themselves manufacture, so that there might be more than one worthy of an award, or even approximately so. The very fact that a certain make of accumulator has done excellent work and is doing it to-day, is sufficient reason to disinterested persons for explaining the attacks and articles which have appeared in your paper.

FREDERICK L. MERRILL.

CHICAGO, Nov. 8, 1894.

THE SUBWAY COMMISSION.

The terms of office of the New York Subway Commissioners expired November first, and, in view of the somewhat chaotic condition of city politics at present, there seems to be considerable doubt whether or not they will become their own successors.

THE ELECTRICAL ENGINEER.

(INCORPORATED)

PUBLISHED EVERY WEDNESDAY AT
303 Broadway, New York.

Telephone: 1323 Cortlandt. Cable Address: LENGINEER.

GEO. M. PHELPS, President. F. R. COLVIN, Treas. and Business Manager.

Edited by
T. COMMERFORD MARTIN AND JOSEPH WETZLER.
Associate Editor: GEORGE B. MULDAUR.New England Editor and Manager, A. C. SHAW, Room 70-630 Atlantic Avenue,
Boston, Mass.Western Editor and Manager, C. KAMMEYER, 1439 Monadnock Building, Chicago,
Ill.New York Representative, 303 Broadway, } W. F. HANES.
Philadelphia Representative, 916 Betz Building, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada	per annum, \$3.00
Four or more Copies, in Clubs (each)	2.50
Great Britain and other Foreign Countries within the Postal Union	5.00
Single Copies,	.10

[Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1893.]

EDITORIAL ANNOUNCEMENTS.

Addresses.—Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of THE ELECTRICAL ENGINEER. Communications for the attention of the editors should be addressed, EDITOR OF THE ELECTRICAL ENGINEER, 303 Broadway, New York City.

Communications suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.

VOL. XVIII. NEW YORK, NOVEMBER 14, 1894. No. 341.

CONTENTS.

EDITORIALS:—

	PAGE
Metropolitan Electrical Traction	306
Railway and Lighting Combinations	390
Refuse Destructors and Electric Stations	399
Using a Third Track	399

ARTICLES:—

An Isolated Storage Battery Plant, Montreal, Can. (Illustr.) L. M. PINOLET.	389
The Perrine Scale for Wiring Calculations. (Illustr.)	391
Electrical Machinist Practice.—IX. (Illustr.)	J. F. HOBART. 392
Recent Sprague Electric Elevator Installations. (Illustr.)	394
The Sewage Destructor Electric Light Plant at Ealing, England. (Illustr.)	395
The Competition of Welsbach Burners with Electricity	396

LETTERS TO THE EDITOR:—

Prevention of Fly Wheel Accidents	J. S. 397
Storage Battery Foes and Friends	F. L. MERRILL. 397

ELECTRIC TRANSPORTATION DEPARTMENT:—

Model Track Construction at Syracuse. (Illustr.)	400
The Baltimore & Ohio's Belt Line. (Illustr.)	401
Underground Electric Roads for Vienna, Berlin and Buda-Pest.	401
Is there a Solution of the Electric Conduit Railroad Problem?—I. (Illustr.)	JOSEPH SACHS. 402
The New York Conduit Electric Railway. (Illustr.)	404

NEWS AND NOTES:—

The Beauties of Government Telegraphy	390
Electrical Utilization of the Falls of the Great Kanawha.	398
The Largest Car House in the World	398
The Subway Commission	397

LITERATURE:—

Allsop's "Induction Coils and Coil Making"	405
Hughes' "Magneto Hand Telephone"	405

SOCIETY AND CLUB NOTES:—

The New York Magnetic Club	405
Electricity on Shipboard	405
Brooklyn Institute of Arts and Sciences	405

LEGAL NOTES:—

Phonograph Litigation	405
Telephone Apparatus Litigation	405

OBITUARY:—

Francis J. Callenan	405
---------------------------	-----

INVENTORS' RECORD:—

Classified Digest of U. S. Electrical Patents Issued October 30, 1894	405
---	-----

TRADE NOTES AND NOVELTIES AND MECHANICAL DEPARTMENT:—

The Kingston Car Wheel Co.—Central Electric New Trolley Wire Clamp. (Illustr.)—The Lunkenheimer Catalogue for 1895.—The White & Middleton Gas Engine	406
Incandescent Lamp Bases in Common Use. (Illustr.)—Electric Appliance Co.—Dixon Crucible Co.	407
The G. E. Magnetic Blow-Out Fuse Carrier. (Illustr.)—Shawmut Fuse-Wire Co.—Philadelphia Electrical Equipment Co.—New England Notes.—Western Notes	408

METROPOLITAN ELECTRICAL TRACTION.

IT was as far back as 1884 that Mr. Daft made his first experiments looking to the operation of the New York elevated roads by electricity. Yet notwithstanding the magnificent opportunity afforded for this system and the example of other successful electric roads of similar character, nothing has been done looking towards the equipment of these roads with the new power. The trolley having been prohibited in New York City below the Harlem, prejudice has thus far barred out electric railways from New York City proper, if we except one short spur of the Huckleberry road about $\frac{1}{4}$ of a mile in length at the upper end of Manhattan Island. On the other hand, cable construction has been rapidly advancing and two new lines have recently been equipped on this system in addition to those already in operation. The Metropolitan Traction Co., the owners of most of the roads in New York City at the present time, are, it would appear, more progressive than the managers of the elevated roads, or they may be looking for a system which would permit them to abandon the horse in New York City entirely without substituting for it a system as expensive as a cable. The prize offered by the Metropolitan Traction Co. for the best design for an electric underground road, albeit the competition came to nothing, must have had some influence in determining the choice of the system which the Company now actually propose to lay down on a section of the Ninth avenue road. The description which we give of the conduit determined on would show that those to whom the final decision was left in the matter have, not unwisely, laid the greatest stress on simplicity of construction, guided, no doubt, as they were by the results at Buda Pest, from which definite data is now obtainable. It will be noted, however, that the spirit of cautiousness has induced the laying down of a regular cable conduit, very slightly modified to accommodate the electrical conductors. This being the case it would hardly be fair to judge of the economy of the electrical system from the cost of the present installation. It goes without saying that the electric conduit can be built cheaper than the cable conduit, and we need only cite the fact that one of the cable roads in New York cost \$150,000 a mile, double track, while another far exceeded even this figure. It must not be supposed, however, that an electric conduit road which is to stand up under the wear and tear of the heavy traffic which will be demanded of it can be put down for a small fraction of the cable conduit cost. In considering this subject, Mr. Joseph Sachs, in his lecture before the New York Electrical Society, printed on another page, gives it as his opinion that a good electric conduit road will not cost less than from \$30,000 per mile of single track, which by no means covers the best type of paving. As between this and the cost of a good overhead system there can, of course, be no comparison. We have no doubt as to the success of the conduit which it is proposed to lay down in New York, and hence we do not consider it premature to discuss the effect on the existing condition of affairs. We are, indeed, prepared to note a general demand for electric conduit railways in every town at present blessed with an electric railroad, from Maine to California, and the Board of Aldermen passing resolutions compelling trolley wires to go underground. It will in

fact be a repetition of the underground electric wire craze which swept over the country some five years ago. But the trolley so completely fills the requirements in regard to safety and economy that the conduit will only be applicable in most exceptional places, and will probably not pay in any cities having less than half a million inhabitants. We might go further and give expression to our belief that though the electric conduits have made little progress in this country, those who are best able to undertake such work have neglected it designedly in order to avoid raising the question which has nearly ruined some of the electric lighting companies in our largest cities. Such an experience the manufacturing companies are in no mood to see repeated in the field of electric railroading. Whether this policy of inaction was a wise one or not the future will show, but it is safe to say that electric railroading in this country could not show a tithe of its present proportions had the conduit been insisted on in our largest cities.

By the vote in this city during the past week another phase of New York electric traction is opened up. It is evident that the people are in favor of a new rapid transit system, guaranteed by municipal backing, and that such an electrical system is soon to be furnished by the Commission and its engineers. The indications are that the city will have an underground double tunnel or double deck road, the equipment of which will be like that of the London road, but generally superior in design and construction. Definite information on the subject will be welcome and may soon be looked for; and meantime we may express our pleasure at the fact that the era of electrical traction in New York City is at last beginning.

RAILWAY AND LIGHTING COMBINATIONS.

As we have already pointed out more than once, there is a marked and natural tendency toward the combination and consolidation of electric lighting and electric railway interests. Probably few of our readers are aware of the extent to which this relatively new departure has already been carried. A careful examination of the field would indicate that there are to-day in the United States about 65 such organizations representing a total investment of about \$17,000,000. This does not include, however, such places as Milwaukee where a certain separateness is maintained between the two interests although they are practically under the same control. It is obvious that in the smaller communities the drift of things especially in these days of economical revision, must be toward the consolidation of interests that have so much in common and which if not united are likely to become ruinously opposed sooner or later. This week we may mention the consolidation at Kearney, Neb.; last week we gave details of that at Helena, Mont., and news comes in steadily of such movements. Electric lighting men have been active promoters of electric railroading; and the more electric railway men learn of electricity, the readier they are to become interested in the further development of the older industry. There is no doubt, also, that there is new opportunity here for the financier, though it is devoutly to be hoped that there will be as little as possible of inflated capitalization on the basis of exaggerated ideas of the saving to be affected.

REFUSE DESTRUCTORS AND ELECTRIC STATIONS.

THE disposal of garbage and street refuse has long occupied the serious attention of our city authorities and one frequently reads of aldermanic committees on tours of inspection to study the question for the benefit of their respective communities. Destruction of refuse by cremation has been carried out for some time past in England, but it is only recently that the utilization of the heat available from the process was advocated in connection with steam generation for electric light plants. Several such combined plants are now in successful operation abroad and as a type of its class we give, on another page, a description of the destructor plant at Ealing, England, operated in connection with the municipal electric lighting plant. An additional feature worthy of note in connection with this installation is the utilization of the sewage outflow for condensing purposes. We see no reason why our own municipal plants should not avail themselves of this source of energy to reduce, first, their expense for fuel, and, secondly, the cost involved in transporting refuse to outlying districts. On the other hand electric plants operated by private companies might find it to their advantage to become the disposers of city refuse which they would without doubt be able to obtain for the asking. The profits in electric lighting have in many cases been reduced to such a narrow margin that every scheme promising a betterment of existing conditions should be carefully investigated.

USING A THIRD TRACK.

A well known steam railway expert commenting upon our discussion (October 31) of the probable change from steam to electricity on the shorter English railroads, remarks: "It does not seem to me possible that one set of rails can answer both conditions, *i. e.*, keep the rails incessantly occupied with trains of the greatest possible frequency, say with single cars or two cars running without schedule; and at the same time get high speeds." This query does, in fact, go to the root of the subject, but it seems to us that the answer lies in the resort to a third track. The New York Elevated has used this method for some time, and would use it even more if it were not to somebody's advantage to prevent it. By its means, even on the present limited scale, the Elevated can and does run its express trains down in the morning and back at night, at high speeds and with results most satisfactory to the passengers; while the two outer tracks are occupied by slow moving trains either way. Now the conditions are very much the same on a large proportion of the English steam roads around the great cities, with several tracks extending for miles out; and we do not see any real difficulty in adjusting the bulk of the express traffic to a third track construction, thus giving a ceaseless service on the outer tracks either way and a very high speed one way at certain hours of the day. The third track would also be available for no small amount of freight traffic in the hours when no expresses were moving. In this way, it seems to us a greater traffic plying incessantly at remunerative low fares, approximating street car fares, can be got upon part of the system, while it will be possible to run the expresses at higher speed than ever.

ELECTRIC TRANSPORTATION DEPARTMENT.

MODEL TRACK CONSTRUCTION AT SYRACUSE.

It was noticeable that at the Atlanta Convention comparatively little attention was devoted to the electrical equipment of roads, while the majority of the papers took up questions relating to management and particularly the question of road bed and track. The importance of this factor in electric railroad operation requires



FIG. 1.

no special pointing out and hence we believe our readers will be interested in the type of track construction adopted by the Syracuse, (N. Y.,) Street Railroad Co., on their new extensions, which work is now being carried out by Messrs. Belden & Seely, of Syracuse.

In the construction of the new sections, the first operation is the construction of a trench 18 feet wide and 21 inches in depth,



FIG. 2.

upon the bottom of which is spread 6 inches of broken stone, the stone being crushed with the firm's own crusher on the street and deposited in the trench with their patent dump wagons. The bottom of the dump wagon is hinged, and by pulling a trigger the entire load is deposited by one movement. By means of this crusher and two patent dump wagons they are enabled to crush and deposit 80 cubic yards of stone per day. Our engraving Fig. 1, gives a fair idea of this portion of the work.

After the stone has been deposited and spread an 8 ton roller is passed over it until the stone is rolled down to five inches in thickness; then, upon the surface of stone is placed one inch of screened gravel. Ties 6 x 8 inches and 7 feet long are then placed upon the gravel; a 90 lb. girder rail with 36" fish plates and 12 bolts, and tie rods 10 feet apart, are then spiked to the ties; the inch of gravel is used for levelling and tamping up the ties, the space between the ties is next filled with crushed stone, and upon this crushed stone there is placed 8" of concrete with headers of granite, as shown in Fig. 2. Finally upon the concrete there is laid a 2 1/4" layer of asphaltum pavement. We would call special attention to the enlignment of the track in Fig. 2. This work was done by an engineer with a transit. We believe this to be an entirely new departure from the method of lining up with the eye and the track is an absolutely perfect line. The engraving Fig. 8 gives a good idea of the trench excavation; the men are in the act of digging the trench 31" in depth. The embankment to the right was also excavated by Messrs. Belden & Seely, cutting the street through, and necessitating the removal of some 20,000 cub. yds. of earth.

The length of this branch when complete will be four miles of double track, being what is called the Solvay Extension. Messrs. Belden & Seely are also constructing four miles of double-track for the same company on South Salina St., and two miles of the same construction on North Salina St. the contract amounting to about

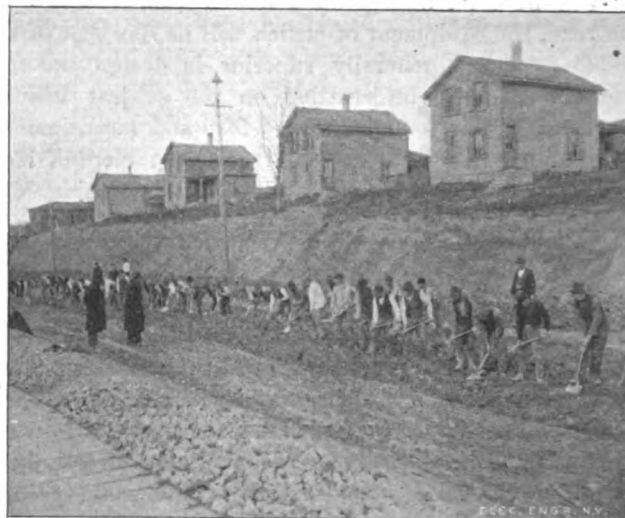


FIG. 3.

\$340,000. The roads are owned by the Syracuse Street Railroad Company, the electrical engineer in charge of the work for the company being Mr. Henry S. Newton. The entire work is under the general supervision of W. R. Kimball, vice president of the Syracuse Street Railroad Company. Messrs. Belden & Seely are the contractors for the entire construction, furnishing all material, excepting car equipments.

TROLLEY FROM NEWARK TO HACKENSACK, N. J.

The purposes of the Union Traction Company of New Jersey, the articles of incorporation of which were filed at Trenton a few days ago, are thus stated by W. F. Ellis, one of the promoters of the enterprise:

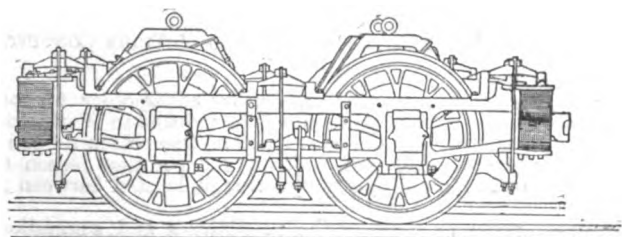
"We intend to provide cross-country facilities not now existing for a portion of Bergen County. We expect first to build as direct a line as possible from Newark to Hackensack, and to place those terminals within twenty-five minutes of each other at a fifteen-cent fare. The time required at present between the places is three hours, and the fare is 65 cents. This fact shows how greatly such a line as we shall give is needed. The line will start from the northern line of Hackensack and pass through the townships or boroughs of Lodi, Carlstadt, New Carlstadt, East Rutherford, Rutherford, Union, Kearney, and Belleville, where direct connection will be made with the Consolidated Traction Company, which runs into Newark. In all the towns touched by the line we

shall build such extensions of the main line as shall be needed. The trunk line will be about sixteen miles long, and the branches will add from ten to fourteen miles more. The railway will be constructed along the first ridge west of the river, and will cross five steam railways, with which we shall probably connect for the purpose of carrying mail, express matter, and freight. There will also probably be a connection with the bridge over the North River, whenever it shall be built. As our line will be essentially a feeder to existing lines, where at present there is none, we shall have no opposition from competitors. For a part of the distance we shall have a double track. The line will be operated by the trolley electric system."

The capital of the new road is \$1,500,000. The incorporators are George S. Forbush of Brookline, Mass.; F. J. Callanen, E. T. Galloway, H. G. Bell, Charles Burrows, J. H. Bell, Rutherford, N. J.; T. G. Hooster, E. Rutherford, N. J.; H. G. Broking, Carlstadt, N. J.; L. H. Levin, J. S. Forgotston, New York City; O. G. Bur-nap, and Frank Gardner, Brooklyn, N. Y. Officers: George S. Forbush, president; H. G. Bell, vice-president; F. J. Callanen, treasurer, and H. C. Ellis, secretary.

THE BALTIMORE AND OHIO'S BELT LINE.¹

THE work on the electrical plant being erected to haul the trains of the Baltimore & Ohio Railroad through the Belt Line tunnel is being pushed to an early completion. The locomotives are finished, and the machinery to generate the electricity is complete and ready for erection, and the power-house is well under way, and it is fully expected that before January 1, 1895, trains will be hauled through the brilliantly lighted tunnel by powerful electric locomotives. The locomotives consist of two trucks, each truck having two axles, and on each axle is mounted a 300-H. P. motor. The motors are gearless, and are supported on springs resting on the frames of the locomotive truck. This method of



ELECTRIC LOCOMOTIVE TRUCK FOR THE BALTIMORE BELT LINE TUNNEL.

suspension leaves the wheels free to adjust themselves to the irregularities of the roadbed and consequently tends to diminish the wear of both tracks and motors. The motor fields are of the iron-clad type, having each separate windings imbedded in the mica-lined slot cut into the periphery of the laminated iron armature. The axles of the locomotive pass through the hollow shaft on which the armatures are mounted. These shafts rest on the bearings of the motor-frame, and are connected to the axles by universal couplings, which allow of freedom of motion in all directions. There are four sets of brushes to each commutator. The motors are controlled by means of series parallel controllers set up in the interior of the cab. The truck, suspended from journal boxes, is to be constructed of heavy beams, which will form the foundation for the locomotive cab, which is of sheet iron, of symmetrical design, and so curved off as to diminish the atmospheric resistance as far as possible. The interior is to be finished in hard wood, with two sliding doors at each side of the cab, and windows so arranged as to permit an unobstructed view in all directions. There will be ample space in the cab for the motorman's movements, and will afford him considerably better protection than that usually vouchsafed the steam locomotive engineer.

The drawing shown herewith is one of the two trucks, and it will be seen that when finished the complete locomotive will be an exceedingly massive piece of machinery, weighing at least 100 tons of 1,200 H. P. traction. It is fitted with air brakes, the air being compressed by a small auxiliary motor in the cab. The electrical air compressor will also operate the whistle. The regulation is such that the speed can be varied from nothing up to 35 or 40 miles per hour, and this can be increased if desired. For the work contemplated, however, 30 miles per hour will probably be the maximum.

The locomotives are to be used in this way: If a freight train is to be pushed through the tunnel, the motor switches behind the train and couples to it without stopping. It then pushes it steadily from the Camden Street end of the tunnel to the portal at Mount Royal Avenue, up a grade of about eight-tenths of one per cent.; then the steam locomotive is also put to work, and the

two of them pull the train up the steeper grade to Huntington Avenue, where the electric motor is detached. For passenger work the electric motor will be coupled to the train at the lower or Lombard Street Station, and will be detached at the upper or Bolton Street Station.

As there will be no smoke in the tunnel, it will be possible to paint its interior white; and as it will be illuminated by about 2,000 incandescent lamps, it will not be necessary to light the lamps in the cars. The difference in comfort between the present plan of a smoky locomotive and a dark tunnel with the cars lighted by a few lamps, as compared with this plan, where there is no smoke, and where there will be brilliant outside illumination, can be easily imagined.

The overhead work necessary to generate the electric current to the locomotives has been specially designed, and will at once be erected. It is expected that the whole plant will soon be in operation, when trains will be regularly run through the tunnel. The electrical work is being carried out under the supervision of Dr. Louis Duncan, electrical engineer for the Baltimore & Ohio.

UNDERGROUND ELECTRIC ROADS FOR VIENNA, BERLIN AND BUDA-PEST.

The Austrian Minister of Commerce has granted to the Austrian Landerbank a concession for an underground electric road in Vienna. This is understood to be the plan for which the Anglo-Austrian Bank and Messrs. Siemens and Halske submitted to the Austrian Board of Trade detailed plans. The railway is to be of narrow gauge, with double track, and is to commence at the Danube Canal, pass under the central city to where it touches the western suburbs, continue under the Maria-Hilf-strasse to the western terminus, and thence to the outskirts of the city to Schönbrunn and Penzing. The railway would be laid deep enough so as not to interfere with the foundations of houses. The journey between the two termini is to be accomplished within eighteen minutes. A single carriage, to be started at short intervals, is intended to convey 40 passengers in ordinary times, while in the morning and evening, and on Sundays and holidays, cars are to be added. Building operations are to commence at seven different points at once, so as to complete the railway in a year from the date of the concession. As there are no means of rapid communication in the central part of the city, the Viennese look with great favor upon the undertaking.

The Berlier electric underground railroad at Paris is to run in almost a straight line from the Bois de Vincennes to the Bois de Boulogne, and the tunnel is to be driven by the use of a cylindrical shield. It is to be an iron tube about 21 ft. in diameter and is to contain two lines of track. In order not to interfere in any way with the street traffic on the surface, lateral tunnels are to lead from the main tunnel to the banks of the Seine, and through these the material is to be carried away. The 17 stations are to be reached from the street surface by elevators and spiral stairways, and the exits into the streets are to be through kiosks on the sidewalks, except in the very heart of the city, where the exits will have to be provided for in houses. The electric current will be fed through a central rail, of square section, which is to rest on glass insulators. A voltage of 500 is to be employed, and the trains are to be made up of four cars, each capable of seating 52 passengers. The inclusive speed is to be about 12 miles an hour, and the trip from one end of the line to the other—a distance of about 6½ miles—is to take 37½ minutes, including the station stops. The cars are to have side doors. Provision is to be made for ventilation by air shafts. There will probably be a uniform fare of 20 centimes. The road is to be ready for service in 1898.

At Budapest, the tunnel will be immediately below the street surface, and the entire street will be closed to traffic during construction. Simultaneously with the building up of the side walls and the laying down of the floor, iron pillars are to be erected at intervals of about 13 feet along the centre line of the tunnel, for the support of longitudinal and cross girders, between which béton arches will be sprung. These will complete the tunnel work proper. On top of the arches will be spread a layer of béton, then a layer of asphalt, and, finally, another layer of béton. On top of this will be laid the wood paving in common use at Budapest. The line will be double track, and the station platforms will be about 75 feet long, affording ample room for two cars. The cars will be propelled electrically, and the current will be supplied through mains carried along the tunnel walls.

One of the features will be the automatic character of the service. When the cars approach a station, the motors will be automatically thrown out of circuit and the brakes applied, and as soon as the train stops the car doors will open themselves, and the brakes will be released. With the closing of the last car door the motors will be again cut into circuit, and the train will proceed. The line will be divided up into sections about 328 ft. long, and each train, as it reaches a block on which there is still another train, will have its motors cut out and brakes set. April 1, 1896, has been put as the date of opening of the road.

1. From the *American Engineer and Railroad Journal*.

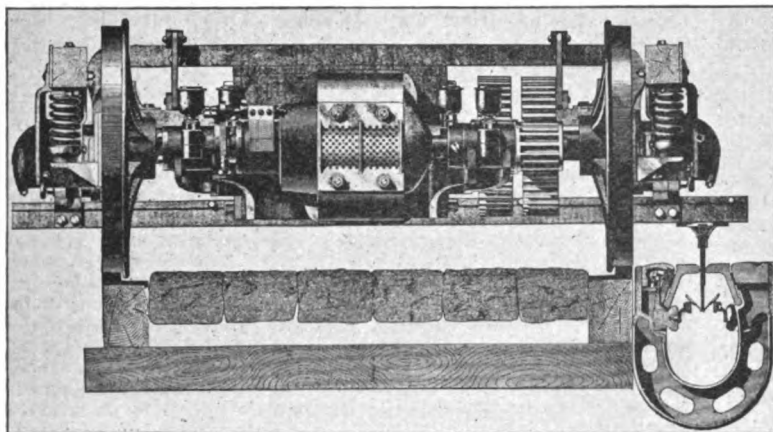
IS THERE A SOLUTION OF THE ELECTRIC CONDUIT RAILWAY PROBLEM? I.

BY JOSEPH SACHS.

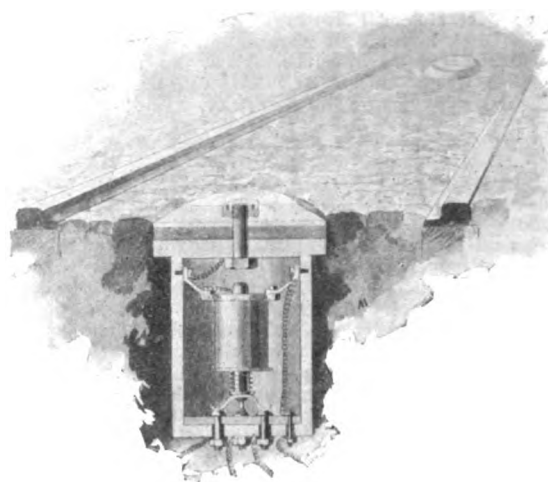
From the fact that there are in operation to-day two electric conduit systems in America, it would appear that we could build other systems of similar character and somewhat similar construction and have them work successfully; but up to date nothing that has been successful, on a commercial basis, has been forthcoming. I think that in order to bring forth a successful system we must first study the problem most thoroughly and the real question to be solved. I have taken up the various systems that have been devised and divided them into six classes, and selected some this evening, of the more important, which I

times. Two wires are used, one each side of the slot, and the whole space around the conduit is filled up and protected by cement. Strange to say, this conduit has been in daily operation, since 1889; dividends are paid by the road, and sixty cars are operating on six miles of double track. But I doubt very much whether a conduit of that size would operate on this side.

The Love conduit is the latest addition to open-slot conduits which is proving more or less successful, and is being used in Chicago. We have here a large conduit, and the wire placed high and dry; furthermore, the most important thing of the system is that the wire is accessible by placing above it a detachable slot rail or cover which can be raised at any time and the wire in-



BENTLEY-KNIGHT MOTOR TRUCK, CONDUIT AND PLOW.



MCLEROY, NICHOLSON AND MCTIGHE CONDUIT.

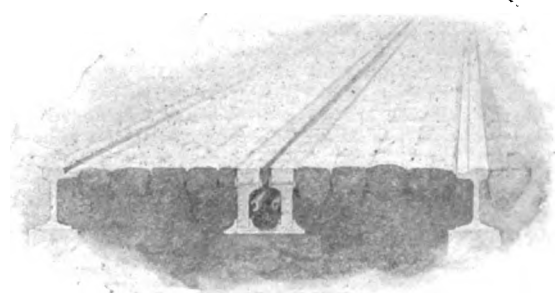
shall describe to you in their various classes, and show you their points of advantage and disadvantage. We shall first take up the various open slot continuous wire conduits.

The first system which I shall show you will be the well-known Bentley-Knight system, which was one of the first attempts ever made in this country to solve the rapid transit problem by means of electricity. It was built in 1884 and consisted of a very small open-slotted conduit with two wires suspended therein. The conduit was exceedingly small and, although this road was operated for some time, it was at last abandoned.

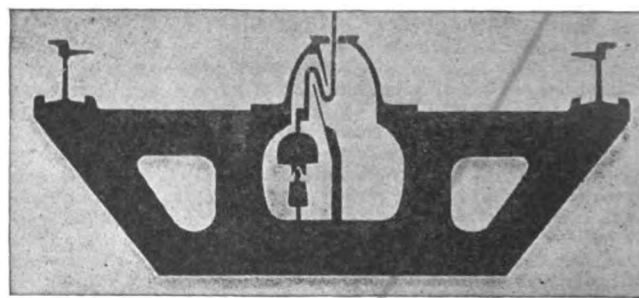
The Bentley-Knight people however, were not satisfied with that attempt and got out another. It had also a very small con-

spected. But apparently it did not prove satisfactory for some reason and when the same system was introduced in Washington they adopted another form of construction. One reason no doubt, was that a cheap conduit was wanted, and for that reason the heavy yoke was replaced by a simple trough located between the tracks.

Now we come to some of the possibilities and suggestions. One is the Griffin conduit, the only feature of which consists in the fact that the conduit is divided into two compartments, in one of which the wire is located and the other for drainage. The advantage of the last form of construction you can readily see for yourself and is also employed in the form of construction which is called the Zell conduit, in which we have a drainage tube in the centre beneath the slot, and the wire is



BLACKPOOL CONDUIT.



GRIFFIN CONDUIT.

duit, but instead of placing it in the middle of the track it was located at the side of the rail.

Another conduit road was installed as early as 1885, and although the conditions would seem to be strongly against its successful operation, strange to say, it is operating to-day and paying dividends; I have reference to the conduit which is operated in Blackpool, England, to-day. The conduit is exceedingly small, and the two wires are supported almost directly below the slot; yet the conduit is in daily operation.

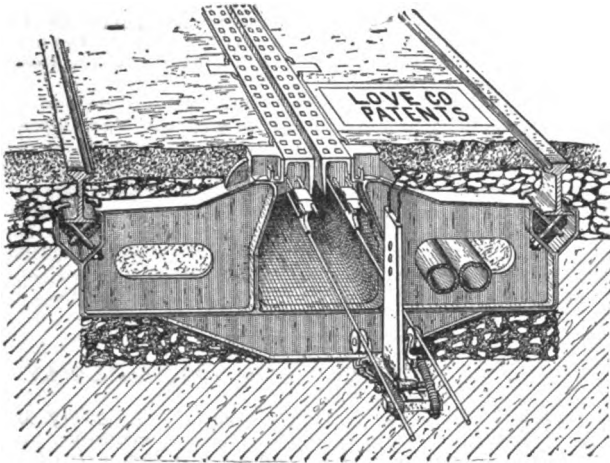
Another system is the far-famed Siemens & Halske system, which is being operated to-day at Buda-Pesth. The conduit is a peculiar one. It is located directly beneath the rail. The car wheel is centrally flanged, so to say, the flange running between the two rails, the object being to keep the slots open at all

supported in two separate compartments, one on each side of the drainage tube.

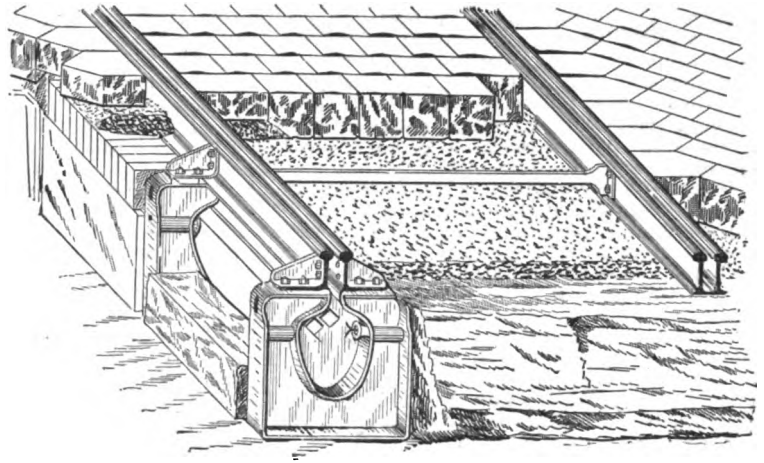
Here are some more suggestions, one of which is very similar to the Bentley-Knight construction. A very complete and well designed conduit is that devised by Mr. Elias Ries as far back as 1887. The other is an oddity. The wire is simply loosely supported on insulators and the trolley wheels pass under the wire and raise it up as it comes along; and after the collector has passed the wire drops back into its supports.

Now you will please take notice that most of these various forms of open-slot conduit which I have mentioned possess several points of disadvantage. First, they have the disadvantage that in nearly all the forms which have been tried the conduit has been extremely small; the wires have been unprotected and poorly located; they have been placed low instead of high, the insulators have been poor and inaccessible, and the

1. Abstract of an illustrated lecture delivered before the N. Y. Electrical Society, Columbia College, Oct. 27, 1894.



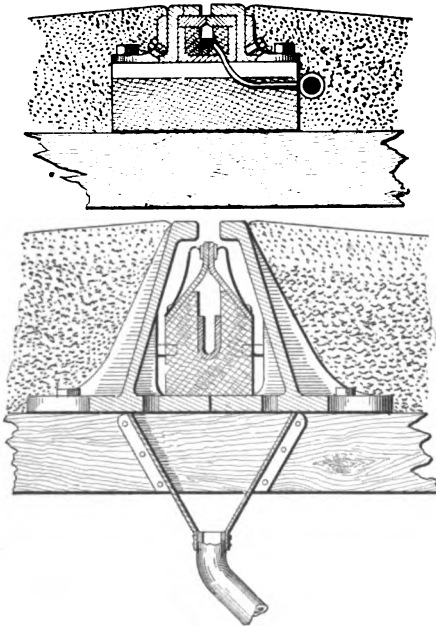
LOVE CONDUIT.



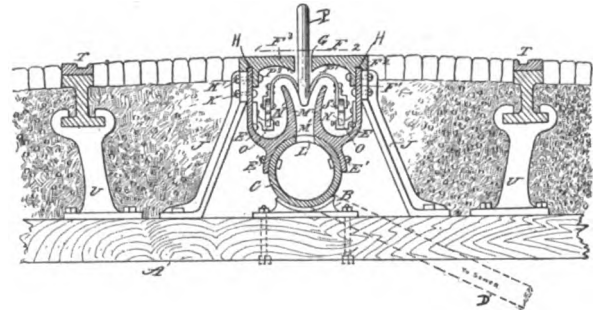
SIEMENS & HALSKE BUDA-PEST CONDUIT.

problem seems to have been attacked from the wrong standpoint, namely, to get a cheap system, to compete with the trolley.

order to do that several inventors have attempted to cover up the slot to keep the slush, mud and dirt out, except when the trolley is passing. One of the best known of this kind of system is the Van Depoele conduit, the invention of the late well-known electrician Mr. Van Depoele. He devised a form of construction having flexible lips, which cover the slot of the conduit containing the wire. The conduit is very small, and there are two lips which press together over the slot and which are pushed aside by the plow of the car as it comes along but close again after the car



VAN DEPOELE FLEXIBLE LIP CONDUITS.



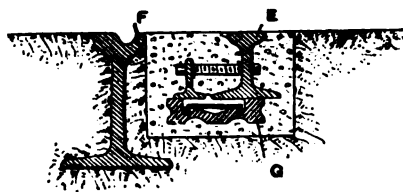
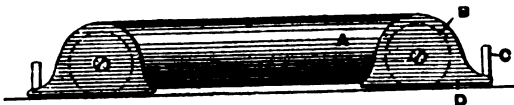
ZELL CONDUIT.

has passed. In another form which Mr. Van Depoele has devised, he puts the same construction inside of a somewhat larger conduit.

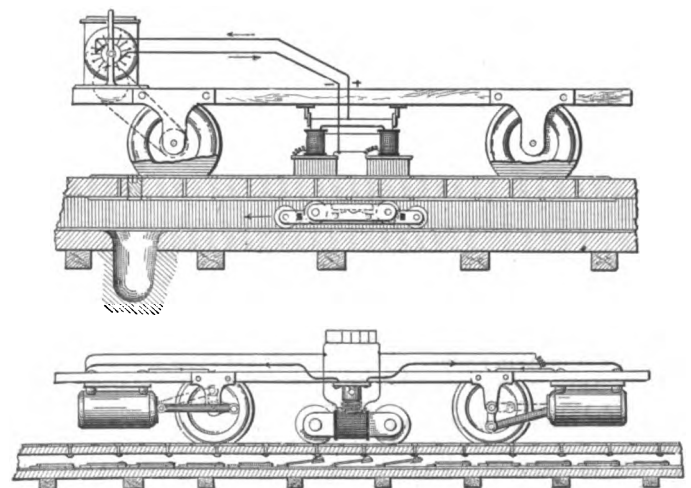
In still another form the wire is located in a trough within the slotted conduit and covered by two shutters which are pushed aside by the plow. These shutters are made in short sections and cover up again after the plow has passed.

Now we come to another system which has recently been exploited in this country, known as the Patterson system. The conduit is very small, and divided into two compartments. The

We will leave the open-slot conduit for a while and take up what we call the "Movable Lip" or "Cover Conduit." In this form of construction the aim has been to protect the wire, and in



LINEFF CONDUIT.



VAN DEPOELE MAGNETIC SURFACE CONTACT SYSTEMS.

wires are located in one compartment and there is a cover which is pushed aside by the plow. This system has not been tried.

The difficulty with these open-slot flexible cover or movable cover conduits is practically the same as with the previous class and possesses the additional disadvantage that we have not got the flexible material that will stand the strain of every-day railway traffic, and the shutters, when made of metal, cause a great deal of noise and do not seem to afford a great deal of protection against injury to the wire.

The next class we come to is known as the "Surface Contact" system. It holds forth certain alluring attractions in the way of cheap first cost and dispensing with the open slot, and has therefore received a great deal of attention. Among these the Lineff system has been tried experimentally. It consists of a sectional iron contact rail which is flush with the street surface. It is made in sections of six to ten feet, placed on top of the conduit, which is entirely closed and is composed of some insulating material in which is laid a strip of copper attached to the bottom of which is a strip of iron, and this composite strip is connected with the source of supply. Upon the car is a magnet having a wheel at each end and placed longitudinally with the track. When the magnet is energized the composite strip is attracted up against the rail and naturally connects that section of the rail with the dynamo.

Another surface contact system devised by Mr. Van Depoele which is practically the same in principle as the Lineff. The contact conductor consists of a number of sections on the surface of the street; the contact device or collecting plow consists of a magnet, the poles of which are brushes. The switching device is a small car which runs upon rails in the conduit and directly

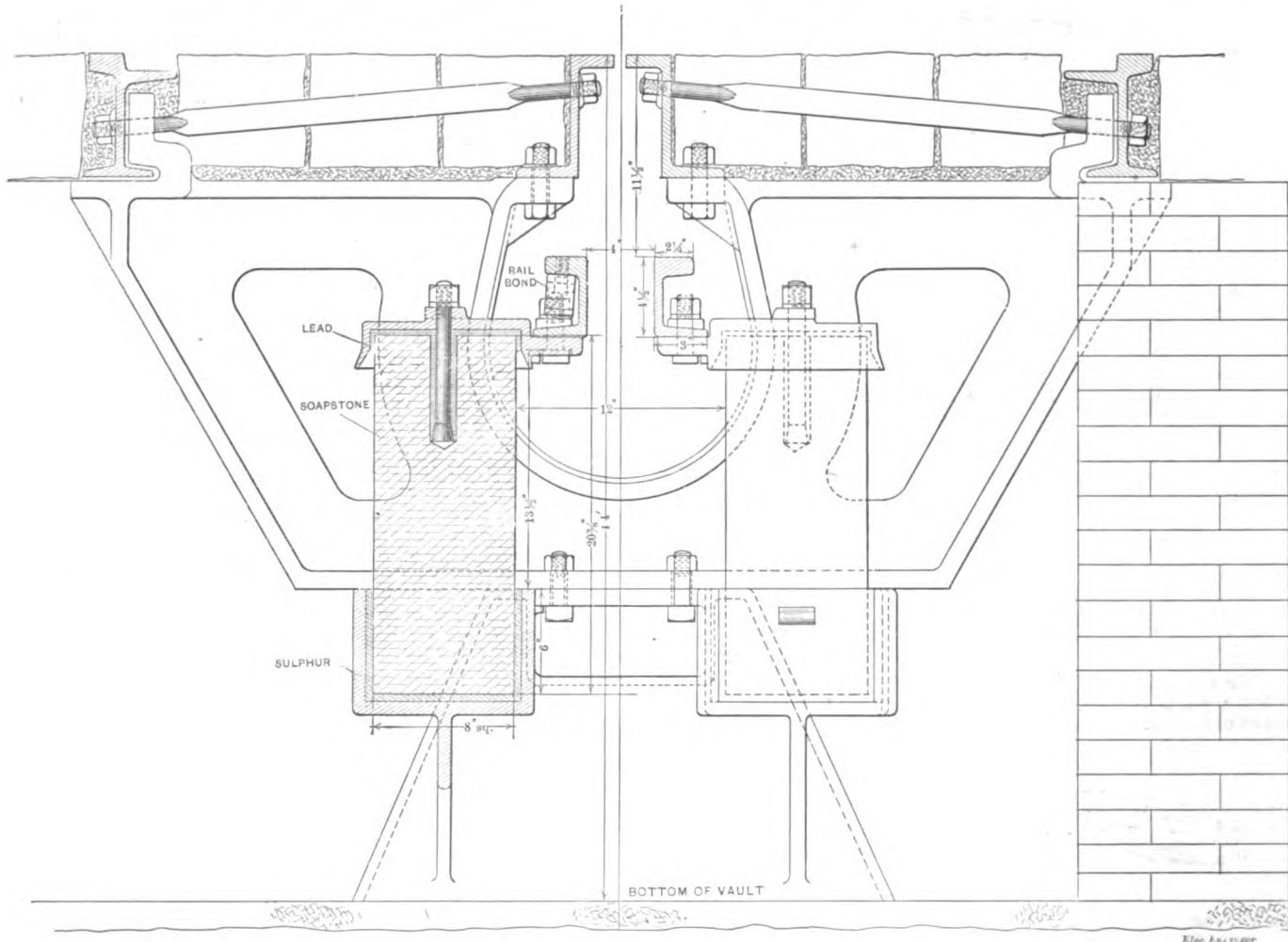
mounted a magnet, the difference being that this magnet is placed transversely instead of longitudinally to the track. The band is pulled up against the rail by the magnet which forms the magnetic switching medium, and also against a central contact, which forms the sectional conductor.

The system devised by Messrs. McElroy, Nicholson & McTighe, is very similar to one of the forms of the Van Depoele system. Instead of using a sectional rail contact, plates are used which are located between the track on boxes in which the switch mechanism is located. The poles of the magnet are very long and project from the plate on one box to the next. In the box a small lever is pivoted and connected to the supply wire. When the magnet on the car is over the box the lever is attracted up against the contact plate and connects the same with the supply wire and the current is taken off by the long bar which forms the pole of the magnet.

THE NEW YORK CONDUIT ELECTRIC RAILWAY.

In his lecture before the New York Electrical Society Mr. Joseph Sachs described the new electric railway conduit which will be put down on the extension of the 9th Ave. cable road running through 116th St. and up Lenox Ave. to 146th St. and the Harlem River.

The conduit, which is illustrated in the accompanying engraving, has been designed by the engineers of the General Electric Co. In order to forestall any possible interruption of traffic in case traction by electricity should prove a failure, the company



NEW YORK CONDUIT ELECTRIC RAILWAY.—SECTION AT MANHOLE.

beneath the sectional contacts. The lower rails form the supply conductor and the car acts as a connection between it and the section above. As the motor car runs along, the magnet beneath pulls along the little car through the conduit and thereby connects each successive section with the supply wire. Another system of Mr. Van Depoele's, consists of a number of levers inside of the conduit beneath the sectional conductor, and as the magnet moves along, the switch levers are pulled up against the respective sections and in that way the contact is made all along the line in each section of surface contact conductor.

Lieutenant Patten's system is very much the same as the Lineff system. It consists of a band of iron, and upon the car is

have decided to put down a cable conduit and at the manholes' thirty feet apart, will be placed upon suitable supports, insulators which are of rectangular form, supported in cups and embedded in sulphur; these insulators are of soapstone, and fastened to the top is an arm of iron. There being two conductors used, no structural return circuit is required. To this arm is fastened the contact conductor which is of channel iron. The contact shoe comes down through the slot and has two arms which press outwardly from the centre supporting bar against the contact rails, making a continuous rubbing contact. Being located in the man-holes the insulators are easily accessible. The voltage intended to be used is about 250 to 300 volts.

LITERATURE.

Induction Coils and Coil Making. By F. C. Allsop. New York, 1894. Spon & Chamberlain. 162 pp. 5 x 7 inches. Price, \$1.25.

OLD as the induction coil is, it has not only not fallen into desuetude, but, on the contrary, has of late been called into renewed prominence by the experiments of Tesla and others in the prosecution of their work on high potential currents. While the construction of induction coils of the old type is not the best suited to obtain the maximum effects, for reasons now well known from the writings of Mr. Tesla, there are still many interesting experiments in this domain which can be performed with the earlier type of coils. In the work before us, the author describes the various methods of winding these coils and gives many useful and practical hints for their construction. He devotes considerable attention to medical coils and various forms of electrodes used by physicians. Those who are prosecuting experiments in vacuum tubes will be interested in the chapter devoted to experiments with the spark coils.

Magneto-Hand Telephone. By Norman Hughes. New York, 1894. Spon & Chamberlain. 80 pp. 4½ x 6. Price, \$1.00.

The little work before us gives very complete instructions, accompanied with illustrations, which will enable any one equipped with a lathe and a few hand tools to make the familiar butter stamp telephone. We also find descriptions of signaling apparatus, and of the battery telephone, with directions for erecting short lines. It is hardly necessary to call special attention to the errors into which the author has fallen where he drifts into theory or hypothesis, but these do not detract from the value of the work to those for whom it is intended.

SOCIETY AND CLUB NOTES.

THE NEW YORK MAGNETIC CLUB.

This club will entertain the Hon. James D. Reid at dinner at Jaeger's, Madison avenue and Fifty-ninth street, on November 21. This banquet is of even date with the annual meeting of the Telegraphers' Mutual Benefit Association, and a large gathering is expected.

ELECTRICITY ON SHIPBOARD.

Members of the American Institute of Electrical Engineers have been invited to attend the second general meeting of the Society of Naval Architects and Marine Engineers to be held at 12 West Thirty-first street, Nov. 15 and 16. Among the papers to be read of special interest to electrical engineers is one by Mr. S. Dana Greene, formerly of the U. S. Navy, on "Electricity on Shipboard—Its present position and future development." There are a great many interesting branches to this theme.

BROOKLYN INSTITUTE OF ARTS AND SCIENCES.—On Monday, Nov. 12, Prof. Wm. A. Anthony delivered the fifth lecture in the course on "Electricity and its Applications to the Arts and Sciences," before the Department of Electricity of the Brooklyn Institute.

LEGAL NOTES.

PHONOGRAPH LITIGATION.

Mr. E. D. Easton, vice-president and general manager of the American Graphophone Co., Washington, has issued a notice of warning of infringement to all users of the Edison phonograph. Proceedings have, it is alleged, been begun against several parties,

TELEPHONE APPARATUS LITIGATION.—THE FIRST GUN.

Suit has been brought in Boston by the Western Electric Company against the Holtzer-Cabot Electric Company, and in Chicago against the Harrison International Telephone Company, for the alleged infringement of a number of magneto-call bell patents. Three suits have been brought against each of these companies; suit number one is for alleged infringement of patents 202,495 and 210,886—Thos. A. Watson, April 16 and December 17, 1878, respectively for Telephone Call Signal Apparatus and for Polarized Armature for Electric Bells. Suit number two is brought on patent 231,424—Thos. A. Watson, November 11, 1879, Hinge for Telephone Boxes, and suit number three on patents 230,264 and 231,790—E. T. Gilliland, July 20, 1880, Magneto Electric Generators for Telephone Call Signals, and E. T. and J. F. Gilliland,

August 31, 1880, Construction of Magnetos. The broadest of these patents is the Watson patent of 1878, the claims of which are as follows:—

1. The combination, with a system of electric telephones, and upon the telephonic circuit, of signaling apparatus and a supplemental electric generator in a branch circuit independent of that containing the telephone, the whole being arranged and adapted to call the attention of distant operators, substantially as shown and described.
2. The combination, with a system of electric telephones, of a supplemental magneto-electric inductor in an independent branch circuit, substantially as shown and described.
3. The combination, with a system of electric telephones, of magneto-electric inductors and call-bells with polarized armatures, the whole being operated substantially as shown and described.

It would seem that any form of magneto generator which is alternately in circuit and out of circuit, infringes this remarkably broad patent. If so, private line or other apparatus to be non-infringing would either require the use of a battery call, or have the magneto permanently in circuit.

No. 210,886 is upon the centrally pivoted armature of the bell, No. 221,424 is upon the spring contact in connection with the hinges of magneto-call apparatus, while Nos. 230,264 and 231,790 are upon the mechanical construction of magneto generators or call boxes.

It is understood that the policy of the Western Electric Company is to protect its interests respecting all its detail and other telephone apparatus patents to the full extent of the law, irrespective of the short time some of these patents have now to run.

OBITUARY.

FRANCIS J. CALLENAN.

We regret to announce the death, from accident, of Mr. F. J. Callenan, the treasurer of the Union Traction Co. recently formed with a capital of \$1,500,000 to operate between Newark, N. J., and Hackensack. He has for some time past been interested in electrical railway enterprises in Brooklyn, Utica, Syracuse and other places. His death occurred through his being pushed from a morning train, in motion, on the Erie road, at Rutherford.

A SIGN OF THE TIMES.

The "Fair," a big dry goods store in Chicago, has been advertising 115 v 16 C. P. Edison lamps at 25 cents. Where did it get them?

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS
ISSUED OCTOBER 30, 1894.

Accumulators:—

Secondary Battery, J. E. Rhett, Salem, Ind., 523,445. Filed Nov. 22, 1893. Employs electrodes consisting of flattened leaden receptacles whose side walls are perforated.

Alarms and Signals:—

Electric Railway Signal, A. J. Wilson, Port Chester, N. Y., 523,245. Filed Nov. 21, 1892.

An automatic electric block signal system for steam railways.

Electric Railway Signal, A. J. Wilson, Port Chester, N. Y., 523,246. Filed Dec. 16, 1892.

Similar to No. 523,245.

Electric Signaling Apparatus for Block Systems, M. S. Reiley, Washington, D. C., 523,444. Filed June 13, 1894.

An automatic electric block signal system for steam railways.

Electric Machine for Railway Systems, E. Deming, New York, 523,465. Filed May 27, 1893.

Relates to mechanism by which the locomotive or train on any given block may open a circuit and at the same time close another circuit at the preceding or following block.

Conductors, Conduits and Insulators:—

Underground Conduit, J. F. Cummings, Detroit, Mich., 523,291. Filed Jan. 16, 1894.

Consists of an outer casing enclosing wooden ducts insulated from each other and from the outer tube by a dielectric surrounding and separating them.

Art of Coating Electric Conductors, A. F. Montgomery, Lincoln, R. I., 523,301. Filed July 2, 1894.

The method consists in moving the covered conductor lengthwise through a vacuum chamber and through a liquid partly filling that chamber.

Distribution:—

Electric Transformer, E. Thomson, Lynn, Mass., 523,188. Filed Jan. 29, 1890.

A converter built up of L shaped sheet iron pieces so assembled so as to leave space for a solid central core piece.

Dynamoes and Motors:—

Armature for Dynamo Electric Machines and Method of Making Same, T. H. Hicks, Detroit, Mich., 523,204. Filed July 14, 1893.

Relates to certain details in the winding and insulation of the conductors surrounding the armature core.

Reversing Mechanism for Electric Motors, J. Mellen, Newport, Ky., and N. O. Goldsmith, Cincinnati, O., 523,440. Filed Feb. 24, 1894.

A reversing instrument so arranged that when the motor is first connected with the main line the armature will revolve in one direction, and, upon the circuit being broken and connected the second time, the armature will revolve in the reverse direction.

Galvanic and Thermo-Electric Batteries:—

Galvanic Battery, M. M. Clark, Chicago, Ill., 528,286. Filed May 27, 1893.
Has for its object to provide means for retaining the depolarizing substance in place around the negative electrode.

Lamps and Appurtenances:—

Electric Arc Lamp, R. Segerdahl, Chicago, Ill., 528,184. Filed Feb. 28, 1894.
Employs a resistance consisting of two parts and secured to both sides of the frame of the lamp.

Measurement:—

Ohmmeter, A. H. Armen, Lynn, Mass., 528,368. Filed April 21, 1894.
Employs an index with an indicating mark, a Wheatstone's bridge, a rheostat and coil, a magnetic needle and pointer vibrating in the coil, and a magnet external to the coil.

Miscellaneous:—

Electrolytic Apparatus for the Manufacture of Chlorin and Caustic Soda, T. Drake, Huddersfield, Eng., 528,158. Filed June 30, 1894.
Thermoset, D. W. Thompson, Chicago, Ill., 528,189. Filed Nov. 19, 1889.
Relates to heat regulating apparatus for furnaces, etc.
Feed Water Purifier, S. L. Bailey, Chicago, Ill., 528,318. Filed Aug. 2, 1894.

Claim 1 follows:—

In combination with a shell or casing, an internal core or cylinder composed of alternate notched or perforated rings and perforated discs, resting one upon another, the exposed surfaces within the shell being of relatively electro-positive and electro-negative substance.

Process of and Apparatus for Electrolytic Decomposition of Alkaline Salts, H. V. Castner, London, Eng., 528,322. Filed Sept. 26, 1892.

Process of Reducing Aluminium, F. A. Gooch, New Haven, Conn., & L. Waldo, Bridgeport, Conn., 528,385. Filed Sept. 1, 1893.

Relates to the process of reducing aluminium from its compounds by the electrolysis of a fused mass containing such compounds.
Feed Water Purifier, S. L. Bailey, Chicago, Ill., 528,512. Filed July 9, 1894.

Claim 1 follows:—In a water purifier, the combination of an outer shell provided with a removable cap, and a series of relatively electro-positive and negative tubes loosely mounted within the shell and freely removable therefrom.

Method of Manufacturing Beer, P. Cropf, Chicago, Ill., 528,374. Filed May 26, 1894.

Claim 1 follows:—The herein described method of manufacturing beer which consists in subjecting the liquor to the first fermentation, and then passing a current of electricity through the partially fermented beer.

Railways and Appliances:—

Trolley Catcher, W. D. Cobb, Fort Worth, Tex., 528,149. Filed May 29, 1894.
Provides means whereby the trolley pole automatically drops the instant the trolley leaves the wire.

Conduit Electric Railway, J. L. Hornig, St. Louis, Mo., 528,305. Filed Feb. 19, 1894.

A conduit consisting of two pieces of insulating material upon the upper sides of whose inner surfaces conductors are placed.

Conduit System of Electric Railways, J. B. Lynn, Cleveland, O., 528,830. Filed Dec. 9, 1893.

Claim 1 follows:—A slot rail formed of beams having a groove therein, a conductor in the bottom of said groove, and a channel iron in the top of said groove, and contacting boxes arranged between said beams, and also provided with grooves to form a continuation of the grooved slot rail.

Closed Conduit Electric Railway, J. F. McLaughlin, Philadelphia, Pa., 528,379. Filed May 10, 1894.

Employs switches closed as the car passes by magnetic attraction.

Supply System for Electric Railways, C. H. Harkins, St. Louis, Mo., 528,477. Filed Dec. 9, 1893.

Employs independent switches at intervals along the track adapted to be engaged by a plate carried by the moving car.

Closed Conduit for Electric Railways, W. E. Stearns, Berlin, Conn., 528,494. Filed Apr. 7, 1894.

Employs a compressible insulating envelope, a conductor enclosed therein and a series of trolley wheels carried by the car and co-operating with the conductor.

Switches and Cut-Outs:—

Automatic Electro Magnetic Cut-Out, L. T. Stanley, Brooklyn, N. Y., & A. E. Braddell, Philadelphia, Pa., 528,185. Filed Aug. 22, 1893.

Claim 1 follows:—

In an automatic cut-out, the combination of the jacketed coil, the movable core or plunger, the pivoted switch lever and co-operating contacts and the push rod of magnetic metal between the switch lever and core.

Rheostat, M. Waddell, Bridgeport, Conn., 528,243. Filed Sept. 6, 1893.

Claim 1 follows:—

A plate for rheostats, having one or more of its edges crimped.

Electromagnetic Switch, J. G. Hartel, Dec'd, F. L. Hartel, Administratrix, Keokuk, Iowa, 528,480. Filed Dec. 2, 1893.

Consists of a switch held closed by a spring actuated catch, a releasing mechanism connected with the catch, and an armature on the field magnet of the motor connecting with the releasing lever.

Telegraph:—

Telegraph Key, C. F. Sebring, Leeds, Mo., 528,345. Filed July 2, 1894.

A self closing attachment applicable to any of the ordinary telegraph keys in general use.

Telephones and Apparatus:—

Mechanical Telephone, J. Prince, Milford, Mass., 528,390. Filed May 16, 1894.

Claim 1 follows:—

In a mechanical telephone the shell inclosing a series of open tubes fixed in position, in combination with a suitable diaphragm and mouth-piece and a conducting wire leading therefrom.

THE KINGSTON CAR WHEEL CO.

A new corporation to be known as the Kingston Car Wheel Company has been organized at Kingston, N. Y., with a capital stock of \$20,000, divided in 400 shares. The following comprise the company: R. B. Brodhead, Frederick Corss, Wm. Loveland, Abram Nesbitt, George Loveland, John G. Wood, George F. Nesbitt, S. B. Vaughn, Christian Bach, E. E. Hoyt, F. C. Sturges and John B. Reynolds.

The following directors have been chosen: R. P. Brodhead, R. B. Vaughn, Fredrick Corss, E. E. Hoyt, George Shoemaker, George Loveland and Frank C. Sturges. The company has been organized for the purpose of manufacturing car wheels of steel or iron.

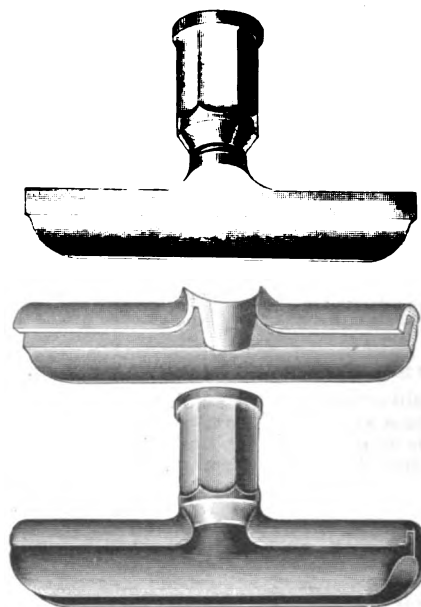
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

CENTRAL ELECTRIC NEW TROLLEY WIRE CLAMP.

The Central Electric Company have developed a new trolley wire clamp, which they are now offering to the trade. The construction of the clamp is such as to give it a very neat and compact appearance, at the same time in no way detracting from the necessary strength. No strain that is brought to bear upon the trolley wire is sufficient to cause this clamp to release its hold. As seen in the illustration, the two parts are locked together in a manner that makes it simply impossible for it to become displaced after being hung. Of course no soldering is necessary. The clamps are made to fit either a $\frac{1}{8}$ or $\frac{1}{4}$ inch stud and are furnished in bronze or malleable iron. No obstruction is offered to the passage of the trolley, it having a perfectly level track to run on, and consequently there is no destructive or wasteful sparking.

Another specialty that the Central Electric Company is ex-



CENTRAL ELECTRIC NEW TROLLEY WIRE CLAMP.

ploting in the West is the Samson battery. These standard goods are like old wines in that they need no bush. No illustration is necessary. Every bell fitter in the country knows the Samson and knows that it is well named. The batteries are clean cut, neat in appearance and do an astonishing amount of hard continuous work.

THE LUNKENHEIMER CATALOGUE FOR 1895.

A handsomely printed and profusely illustrated catalogue for 1895 has been issued by the Lunkenheimer Co., of Cincinnati, Ohio, devoted to valves, lubricators and steam specialties. All the steam goods of this company are made according to the United States standard of steam composition, and have become so popular that branches have been opened for their sale in New York and London. Besides a great deal of apparatus well known to steam users, the catalogue contains descriptions of several new styles of valves, etc., and is a credit alike to the company, the compiler and the printer.

THE WHITE & MIDDLETON GAS ENGINE.

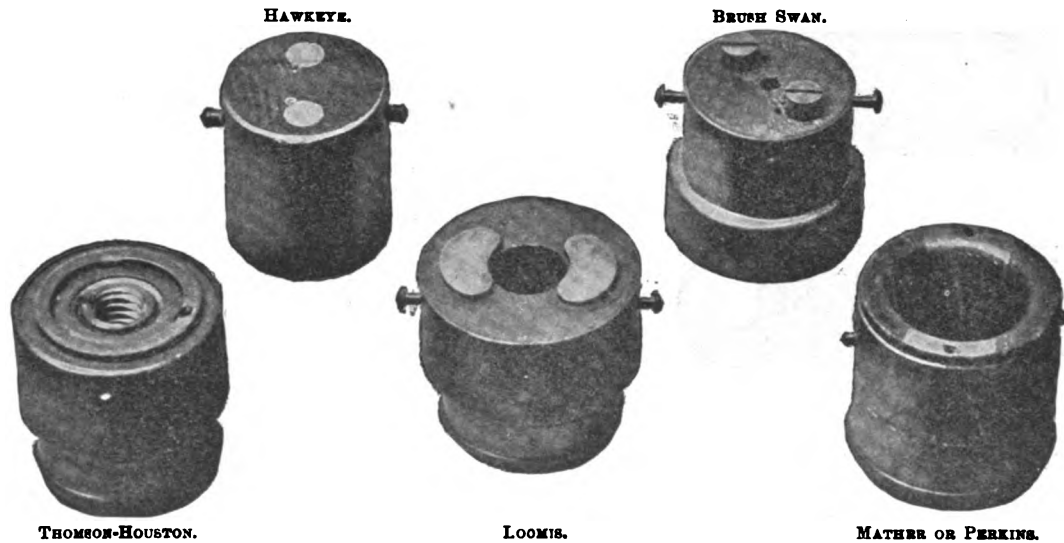
The White & Middleton Gas Engine Co., of Baltimore have recently issued a circular on electric lighting, a field upon which the company is just entering with very satisfactory results. These engines are guaranteed not to consume more than 17 cubic feet of gas per actual brake H. P. per hour with gas of equal quality with that used in Baltimore. They run very steadily and noiselessly, require little attention and have few parts. The governor is simple and substantial, is attached directly to the crank shaft, and insures regular speed under variable loads, controlling the quantity of gas to the amount of work. This is an important consideration in electric work, and its ease of regulation, combined with its other excellent qualities eminently fits this engine for the exacting conditions which it will be compelled to meet in its new field.

INCANDESCENT LAMP BASES IN COMMON USE.

A very frequent source of annoyance experienced by incandescent lamp manufacturers is due to the common habit which their customers have of writing or telegraphing orders for so many lamps of certain voltage and candlepower, but without mentioning in any way the style of base desired, so that the lamps when received may fit the sockets in use.

PRESERVATION OF METALS USED IN ROOFS, BRIDGES, AND CONSTRUCTION WORK.

At the Montreal meeting of the American Society of Mechanical Engineers, an interesting paper was read on methods for preserving metal used in pipes, roofs, bridges, poles, construction work, etc. In conclusion, the whole question of how best to protect iron and steel from corrosion in all the varying conditions

**INCANDESCENT LAMP BASES IN COMMON USE.**

Copyrighted by H. S. Kaliske, of the Beacon Vacuum Pump & Electrical Co.

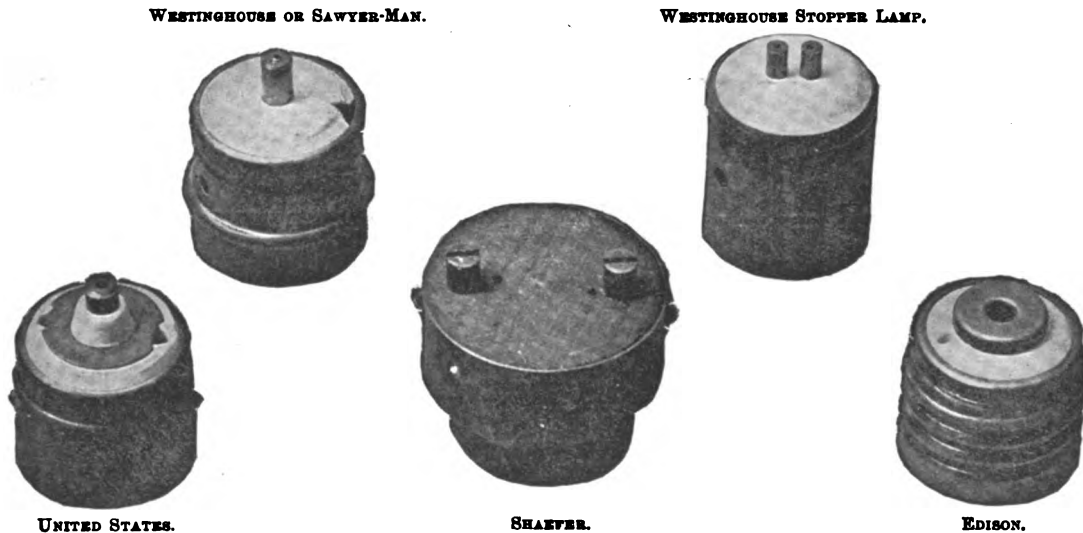
To obviate this trouble in a large measure Mr. H. S. Kaliske, of the Beacon Vacuum Pump and Electrical Co., of Boston, has just issued a neat little card giving illustrations of ten different kinds of bases in common use. This card Mr. Kaliske has copyrighted, and we are indebted to his courtesy for the use of the accompanying illustrations, which are so clear as to require no further explanation. When ordering now, a customer who is provided with one of these cards, is hardly likely to make any

that the wants and usages of to-day demand, seems to resolve itself into several "Don'ts," as the best method of answering it, to wit:

Don't have any scale on the metal.

Don't paint it with anything but pure linseed oil and oxide of lead or graphite paints.

Don't forget that frequent inspection and care are very necessary.

**INCANDESCENT LAMP BASES IN COMMON USE.**

Copyrighted by H. S. Kaliske, of the Beacon Vacuum Pump & Electrical Co.

mistake, avoiding delay and extra expense incurred by telegraphing to and fro, and we consider that Mr. Kaliske has done the consumers of incandescent lamps a valuable service in issuing the card referred to, as many of them are not at all familiar with the different styles of bases, and are consequently unaware of the necessity of ordering them for any specific style.

"FOUR YEARS MORE"

THE ELECTRIC APPLIANCE COMPANY are celebrating the fact that they are just about entering upon their fourth business year, and find additional reason for being joyful in the fact that its beginning is so auspicious, as they are experiencing a splendid run of business and enjoying exceptional prosperity.

Don't let the cost and interest accounts be the governing factors in the case of protecting any metal structure on whose continuity and strength human life and safety depend.

In comparing the two paints recommended, it may be well to add, say the Jos. Dixon Crucible Co., that a properly made graphite paint should prove more durable and a better protector than oxide of lead. Graphite has a strong affinity for metal surfaces, and experienced painters claim that even where light colors are desirable, graphite paint should be used as a priming coat. Again, graphite is impervious to the action of heat, cold, sea air, acid or alkali fumes, which are more or less destructive agents to lead paints.

The Joseph Dixon Crucible Co., Jersey City, N. J., have manufactured a pure linseed oil and graphite paint for over 25 years, and have some very convincing testimonials of its value.

THE G. E. MAGNETIC BLOW-OUT FUSE CARRIER.

An interesting experiment was recently made at the Kent Avenue Station of the Brooklyn City Railroad Co. to test the efficacy of the magnetic blow-out principle in the fuse carriers which form part of the General Electric Company's generator equipment. Previous to the test there had been, on the part of the railroad company, no little scepticism as to the value of the magnetic blow-out principle, and the test was made with the view



FIG. 1.—MAGNETICALLY BLOWN FUSE.

primarily of proving the correctness of the claims of the manufacturing company that the apparatus would cope with almost any demand made upon it.

The test was made on the Company's dock behind the station under the supervision of Mr. Walter A. Pearson superintendent of the station. Six water rheostats of large capacity were connected in the circuit in series in order to regulate the load, and the conductors were brought directly from two of the four 1500 K. W. multipolar generators. The fuse blew at 4400 amperes at 550 volts, equivalent to 8343 H. P. The result of the test was a complete demonstration of the efficacy of the magnetic blow-out on a very powerful and destructive arc. The engraving Fig. 1 shows the blown fuse and one of similar capacity intact. It will be seen that the action of the magnetic blow-out must have been instantaneous, and perhaps the most remarkable feature is the small amount of metal blown.

The magnetic blow-out principle is a special characteristic of all apparatus manufactured by the General Electric Company

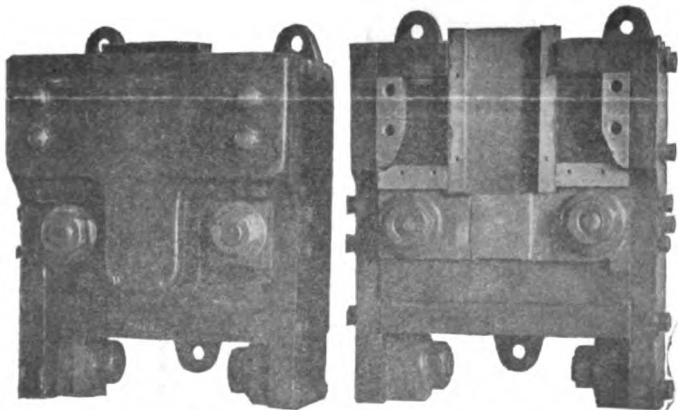


FIG. 2.—G. E. MAGNETIC BLOW-OUT FUSE CARRIER.

which has to deal with possible arcs. It is successfully embodied in the well known "K" car controller as well as in the lightning arresters, fuse-boxes, etc.

The fuse box in which the fuse shown in Fig. 1 was blown was exhibited at the Atlanta Convention and served to convince many who had doubted the efficacy of the magnetic blow-out principle. It is illustrated in Fig. 2.

THE SHAWMUT FUSE WIRE COMPANY.

The Shawmut Fuse Wire Company, of Boston, has issued a handsome 32 page catalogue descriptive of fuse wire, links and ribbons, and containing, in addition, an excellent paper on "Fuse Wire and its Use," illustrated by diagrams. The Shawmut was the first tested fuse wire to make its appearance and holds a high place in the trade, on account of the care used in its manufacture, its excellent quality and the good features proved for it by the tests of the Massachusetts Electrical Engineering Co. It is made

of a special alloy drawn smoothly and accurately, and is remarkably homogeneous and constant in its action.

It is the company's practice to have its products tested constantly, and to furnish a certificate showing what the wire or link has done under standard conditions.

PHILADELPHIA ELECTRICAL EQUIPMENT CO.

The above named concern has recently been organized under very favorable auspices and has begun business at Nos. 816-18-20-22 Cherry street, Philadelphia. Mr. James R. Rettew is secretary and treasurer and Mr. Carl P. Young is general manager. The latter gentleman is well known in the electrical field and has spent some 28 years in mechanical and electrical engineering. He had the advantage in electric railway work of beginning when things began and he has kept up with the procession during the past nine busy years. He was associated with the old Fuller-Wood Dynamo Co.; with Frank Sprague, Leo Daft and Edmond Julien in their historical traction work with overhead trolleys or with storage batteries; and he has also been connected with active work at Chattanooga where he was electric railway superintendent for three years; while he has lately been engaged on the fine new Hestonville, Fairmount & Mantua road in Philadelphia. This large, varied and ample experience he has rounded out by work for the E. P. Allis Corliss engine and the Southern Pacific Railway Co. The Company which Messrs. Rettew and Young will manage will build electric roads and equip lighting plants, and will have competent men in charge of each department. They will handle all necessary supplies and are ready to quote reasonable prices on engines, dynamos, pumps, switchboards, boilers, etc. They will also undertake repairs, winding of armatures, etc., and in short do all the work that a live, energetic, well-posted concern of the kind can get its hands on.

NEW ENGLAND NOTES.

BOSTON ELECTRIC LIGHT Co.—This company through Mr. Orford has been placing orders for underground cables. It is said that the first order covered about 23 miles of No. 6, six miles of No. 0000 and two miles of No. 00, and that it has been divided up among the Kerite, Safety, Norwich, Habirshaw, Washburn & Moen and Clark concerns.

THE MORSE ROTARY ENGINE which was illustrated and described in *THE ELECTRICAL ENGINEER* for Nov. 7, and for which the tests made by Mr. R. A. Stewart at the Mass. Institute of Technology would indicate a wide range of use, is to be introduced and pushed by the energetic Campbell Electrical Supply Co., of 104 High Street, Boston, who have its exclusive control for electrical work. It is worthy of mention that the bank of lamps shown back of the dynamo, are of the "Century" make, also handled by the Campbell Co.

WESTERN NOTES.

THE WASHINGTON ELECTRIC Co., Chicago, have again found it necessary to increase their manufacturing facilities by renting additional space at their factory. They are at present filling some large orders for telephone switch boards, containing some valuable improvements made by their Mr. Meissner.

H. D. SMITH, of Sioux Rapids, Iowa, has closed a contract with the Fort Wayne Electric Corporation, through their Omaha agent, Mr. E. T. Pardee, for a 500 light Fort Wayne alternating dynamo, together with 300 light capacity of the new "Wood" transformer. The plant is to be installed in Mr. Smith's new mill in connection with a new Reynolds Corliss engine.

MESSRS. WM. TAYLOR AND A. W. DEE, formerly of the firm of Taylor, Dee & Mack, have opened offices in the Monon Building, Chicago, and will act as manufacturers' agents for American lamps, Perret motors, Solar carbons, Acme oil filters, as well as other first-class specialties. Both gentlemen are well and favorably known to the electrical trade and will receive a large share of the business.

THE METROPOLITAN ELECTRIC Co. report business as being considerably better in nearly all lines, orders for N. I. R. rubber-covered wires, I. X. L. line wire, and P. & B. compounds especially being very numerous. Their special catalogue of electric railway appliances, issued some time ago, has been productive of very good results to judge from the number of orders being received in that department.

Departmental Items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE Electrical Engineer.

Vol. XVIII.

NOVEMBER 21, 1894.

No. 342.



THE ELECTRIC RAILWAY SYSTEM OF TORONTO, CANADA.

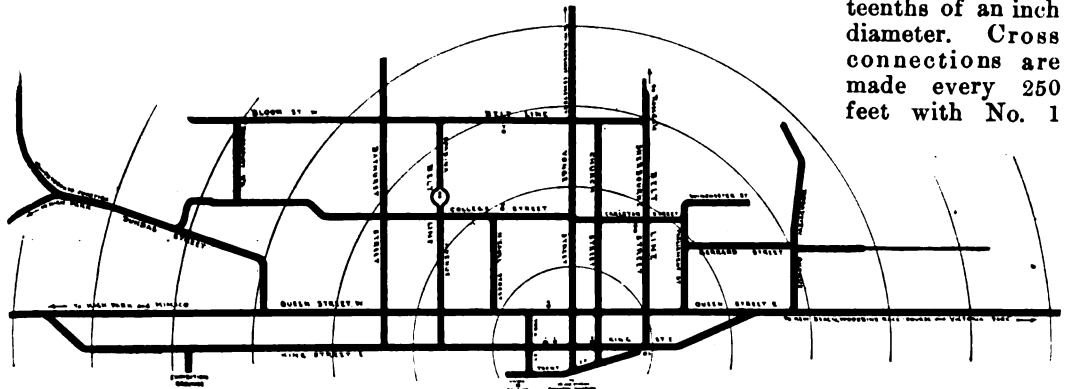
IT is natural that the Toronto electric railway system should attract attention, and that its workings should be carefully studied. The successful operation of a large system so far north; the peculiar relations existing by law between the city and the company; the variety of services performed; and the entire absence of a Sunday schedule—these and other features combine to render Toronto a centre of interest for street railway owners and engineers in all parts of the world. Incidental reference to the work attempted and carried out in Toronto has been made from time to time in the pages of *THE ELECTRICAL ENGINEER*; but it is believed that a brief account of the system as a whole, as it stands to-day with a scientifically complete and rounded out system may be found at once instructive and suggestive. The notes here given are based upon personal observation during the past summer, supplemented by data furnished through the courtesy of the Toronto Railway Company, in whom rests the exclusive franchise to operate surface roads in the city for 30 years.

The original charter for the street railway system of Toronto was granted in 1861. When it expired in 1891 the city did not renew the franchise, but exercised the alternate right to purchase the property of the retiring company. The price, which was fixed by arbitration, was \$1,500,000. The plant and the franchise were then offered for sale to the highest bidder and were purchased at the appraisal of the arbitrators. But, in addition to receiving what it paid for the property, the city reserved the right to regulate the service of the system, including the privilege of ordering its extension in any direction within the city limits. The purchasing company was required to enter into an agreement to keep its fares within

stipulated limits, to provide comfortable and commodious cars, to adopt rules to prevent overcrowding and to make proper provisions for the protection and comfort of its employees. The company not only agreed to these restrictions, but contracted to pay the city royalty of \$800 a year for every mile of single track. It also bound itself to turn over to the city the following percentage of its earnings: On gross receipts, up to \$1,000,000 per annum, 8 per cent; between \$1,000,000 and \$1,500,000 per annum, 10 per cent.; between \$1,500,000 and \$2,000,000 per annum, 15 per cent.; and on all gross receipts over \$2,000,000 per annum, 20 per cent. The cash fare is five cents, which with transfer, gives a ride of over 10 miles. Tickets are sold 6 for 25 cents, labor tickets 8 for 25 cents and school tickets 10 for 25 cents. Between 12 p. m. and 5.30 a. m. 10 cents is charged as a night fare. On Sunday, "the rich may ride in their chaises," but there are no trolley cars. The people voted against them about a year ago by a small majority, and the question cannot come up again before 1896. The company and the city are thus deprived of one day's income in every seven, but probably the public is by far the greatest sufferer, for Toronto is a city of handsome distances.

We illustrate herewith the existing trolley system in a clear and comprehensive little map. The city starts from Lake Ontario at the foot of the map, and the lines spread east and west, as well as run back north, never striking a grade of over 5 per cent., and having usually fine open well-built up streets to run through. Toronto is a comely city, and the solid construction of the trolley system in no-wise mars its beauty; or, at least, in view of the enormous convenience gained, there is the minimum of the utilitarian features that must accompany any surface method of rapid transit. Moreover, the streets, under the new regime, have been admirably paved. Concurrently with the laying of new track, the city has laid solid, permanent pavement, and to-day the Toronto Railway Co. has 81 miles of road which compares more than favorably with that of any other city in the world, of the same population. The rail used is 73 pound grooved-girder, of English make, laid on cedar ties. All curves are 45 and 50 feet radius. The rail bonds are No. 0 copper wire, 36 inches long, connected by special

rivets of seven-sixteenths of an inch diameter. Cross connections are made every 250 feet with No. 1

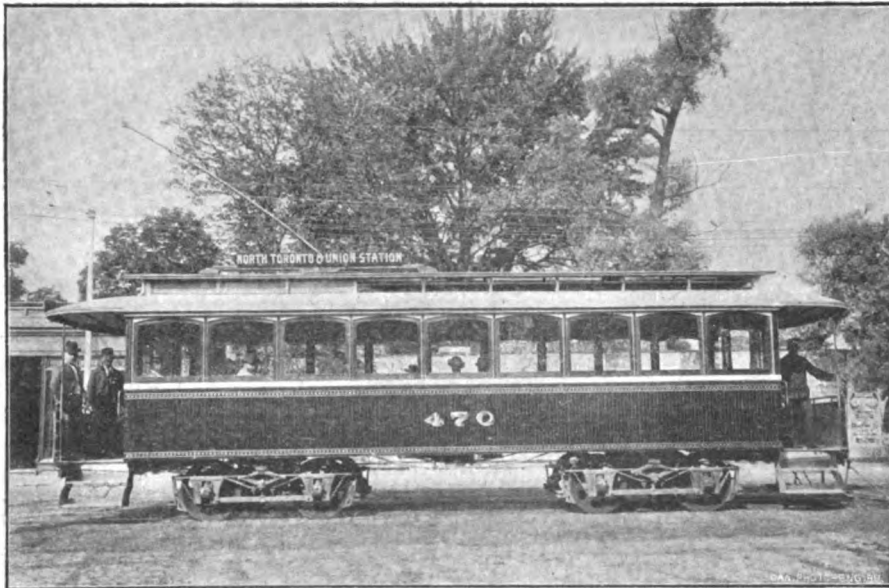


MAP OF TORONTO RAILWAY TROLLEY SYSTEM.

wire, and the net work is also connected at intervals with the water mains. The following precautions have been adopted: At a point near the power house a copper band, 12 inches by $\frac{1}{2}$ inch is fastened around a 20-inch gas main, the pipe having been carefully scraped before the band was

Yonge street might perhaps be called the backbone of the system, and its junction with King street is one of the busiest corners. There is a four minute service on both streets, as well as others here converging, and nearly 3,000 trains, or about 5,000 cars pass this point every day. All

told the company has about 420 cars, some of which are devoted to special and interesting purposes. The newer cars of the company are of the "Palace" type illustrated, 40 feet over all, with double wheel base, capable of carrying 120 passengers. The company is building its own cars very successfully; those hitherto made have been 28 feet over all. It also has beautiful private cars for hire, and it was the writer's good fortune last summer to attend in one of them an afternoon tea and reception given at Scarborough, by Mrs. W. McKenzie, wife of the president of the road. Another special car that has become a favorite is the "Moonlight Excursion" one, the hiring of which has grown into quite a fad, for clearshiny, sentimental nights. Of a very different character are the mammoth street sprinklers here shown. The company is under contract with the city for a service of four sprinklings per day. In the down town sections during the heat of summer, there is a service as often as thirty minutes. For this the company re-



FORTY-FOOT PALACE CAR, TORONTO ELECTRIC RAILWAY.

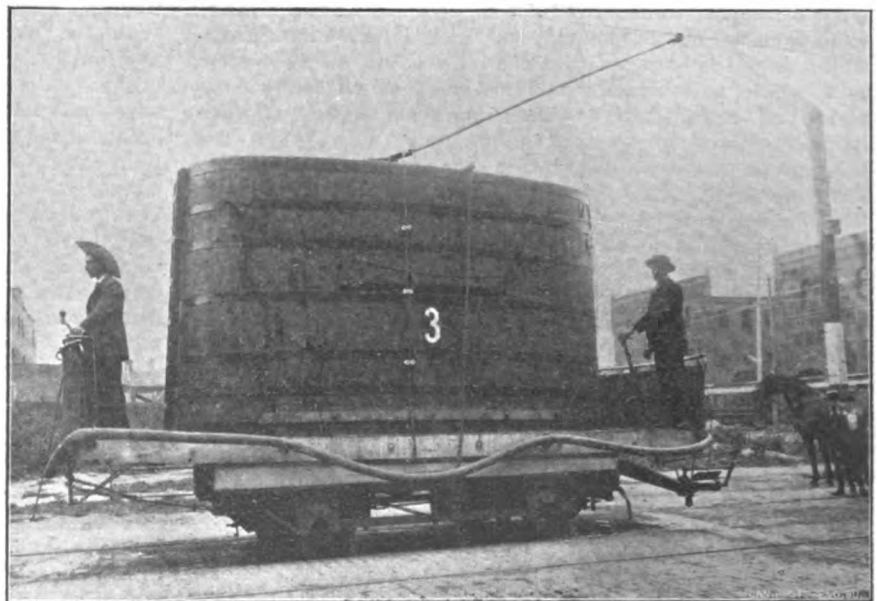
put on. After the band was placed, hot solder was poured on so as to leave no spaces between the pipe and the band. This band is well clamped together and bolted, and from it five half-inch copper wires have been taken to the negative side of the dynamos in the power house. Connections have also been made from a water pipe in the locality in a similar manner. At seven different points, within a radius of a mile where the traffic is the greatest, one-half inch copper wires are connected from the water mains to the rails and are carried back overhead to the dynamos, and they are about to increase the number of these connections. Besides, numerous connections have been made as already stated between the rails and water pipes. The rails are large, and firmly imbedded in concrete, thus making the joint more secure. The road has been operated by electricity for over two years, and although numerous excavations have been made, both by the gas company and the water works department of the city, so far no electrolytic action upon the pipes of either has been detected; nor, as far as has been ascertained, has any injury resulted to the telephone company, whose wires are also underground, enclosed in lead pipes in conduits. The railway company have had in use during the past year 130 motor cars, and the current has averaged 2,000 amperes.

Some idea of the amount of traffic done by the Company, over its systems may be formed from the following:

	Miles.	Population.	Passengers.	Receipts.
1898.....	76.4	189,000	20,649,661	\$877,610
1894.....	81.9	190,000	21,970,950	929,834

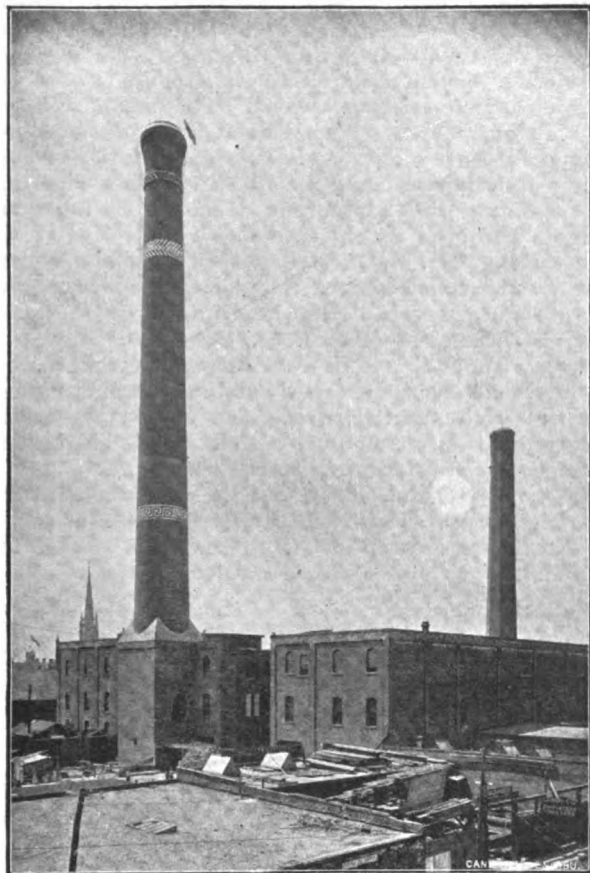
It will be seen that if Sunday were an open day, the company would carry annually not less than 25,000,000 passengers.

ceives only 65 cents per mile of road, which seems like an extraordinarily low rate, as the service is a great boon and is remarkably efficient. Each of these trolley sprinklers has a capacity of 3,000 gallons of water, and they are built at the company's own shops in Toronto, where are also made other cars, snow sweepers, etc., not only for local consumption but for Montreal, St. John and



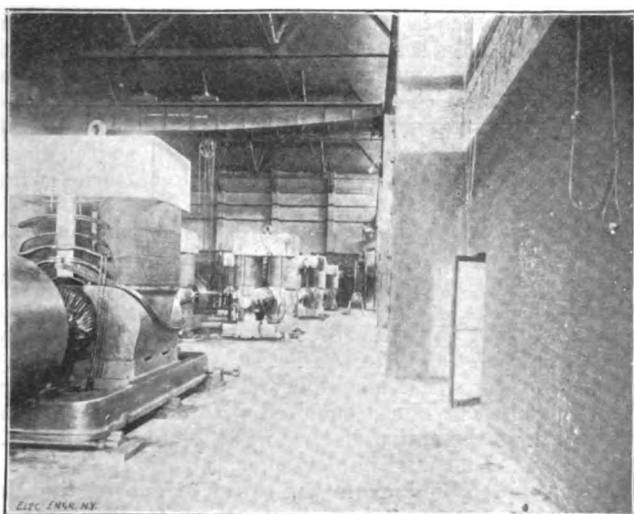
STREET SPRINKLER CAR, TORONTO ELECTRIC RAILWAY.

other places. Before leaving this part of the subject it may be added that the company has made a trial of conveying the city garbage in trolley cars at night. The cars are mostly mounted on Brill and McGuire trucks, and equipped chiefly with Edison and Westinghouse motors. The motor cars have electric heaters, some of which the company has made for itself, and are electrically lighted.



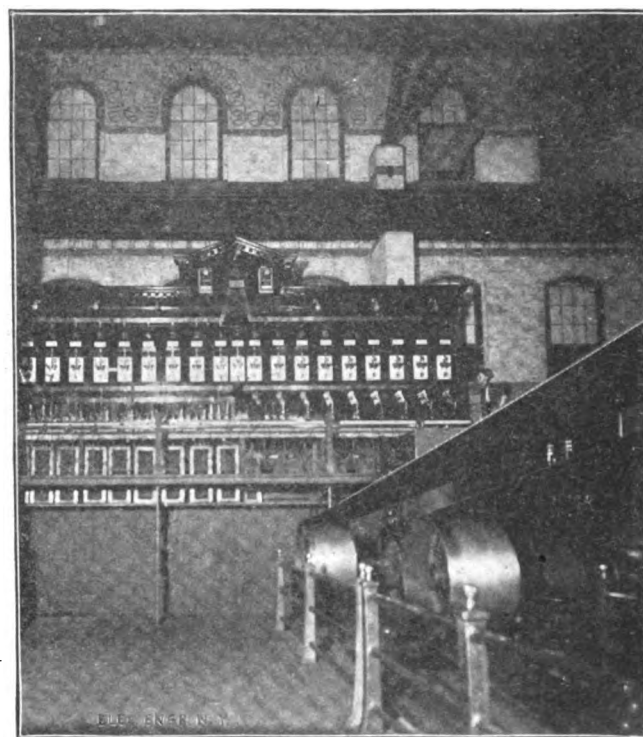
NEW WING AND CHIMNEY OF THE TORONTO RAILWAY POWER HOUSE.

Coming to the power house, attention need hardly be directed to the superb brick chimney, which lifts its graceful shaft 250 feet into the air, and can be seen for pretty well 50 miles around. As one approaches by the Lake it is the first object to catch the eye beyond the line of water. On the right of our engraving is seen the old chimney, still in service for the power plant here illustrated, occupying part of the old building, once a car stable. There are in fact two generating plants, the newer one just coming into operation now; and it is intended that they shall operate in unison. The new station is immediately adjoining and south of the old one, being separated by a brick wall only, and that simply for better fire protection. Doors of iron make access easy from one to the other, and the station



DYNAMO ROOM; TORONTO RAILWAY POWER HOUSE.

board is situated in the corner nearest to the board here shown, in the old plant; which of course brings the network of wires out at practically the same place. The boilers are of the well known Polson make, and furnish steam in the old plant to five 600 h. p. Armstrong & Sims engines, which drive ten 200 kw. Edison generators. These engines are compound condensing, with Corliss type valve gear for the low pressure cylinder, giving a quick cut-off. The engines can be run non-condensing. For condensing purposes, there is a 30-inch pipe running a distance of 620 feet, to the Lake, under water right out. All conductors are carried to the switchboard from the dynamos under the floor. The board is of slate framed in wrought iron. The instruments are of usual construction. There is a Wurts lightning arrester of the familiar tank type, and the eleven feeders at their exit are safeguarded by Wason four-fuse lightning arresters. An ingenious provision of forced draft of air was made to keep the machines cool should they be overloaded, but the big new plant renders such measures less necessary. This addition comprises two 1500 h. p. Corliss compound condensing engines direct connected with two large generators of a similar rated capacity. One



SWITCHBOARD IN DYNAMO ROOM.

engine was supplied by the Laurie Engine Co. of Montreal, and the other by the Bertram Engine Works Co. of Toronto. The Canadian General Electric Co. has furnished one of the large generators, and the other is of Siemens & Halske's Chicago make. The former is coupled with the Laurie engine and is the first to start up. It will be seen that all told, the company has a capacity of 6000 h. p. Besides its power plant, it has several well placed car barns.

From what has been said it will be evident that the company is favorably circumstanced and that its many advantages of position should enable it to become steadily profitable to those who have with such great energy and enterprise developed the large system now in full operation. The travel is not only growing in bulk, but the habit of travel is gaining, the rate now being 110 trips per head per annum, not counting Sundays; or exactly double the rate in 1884. It is, indeed, impossible that with the

increased facilities and fine equipment the growth of patronage should not be both large and rapid.

The capital stock of the company is \$6,000,000 and it has \$2,800,000 bonds issued. The officers are Wm. McKenzie, president; H. A. Everett (of Cleveland, O.), vice-president, J. C. Grace, secretary-treasurer; J. M. Smith, comptroller; James Gunn, superintendent, and W. E. Davis, electrical engineer. Mr. C. E. A. Carr, of the company, has recently compiled an extremely clever little brochure for local distribution on "Toronto as seen from the street cars," and to him is due much of the data embodied in the present article.

THE WINDMILL ELECTRIC LIGHTING PLANT AT MARBLEHEAD NECK, MASS.

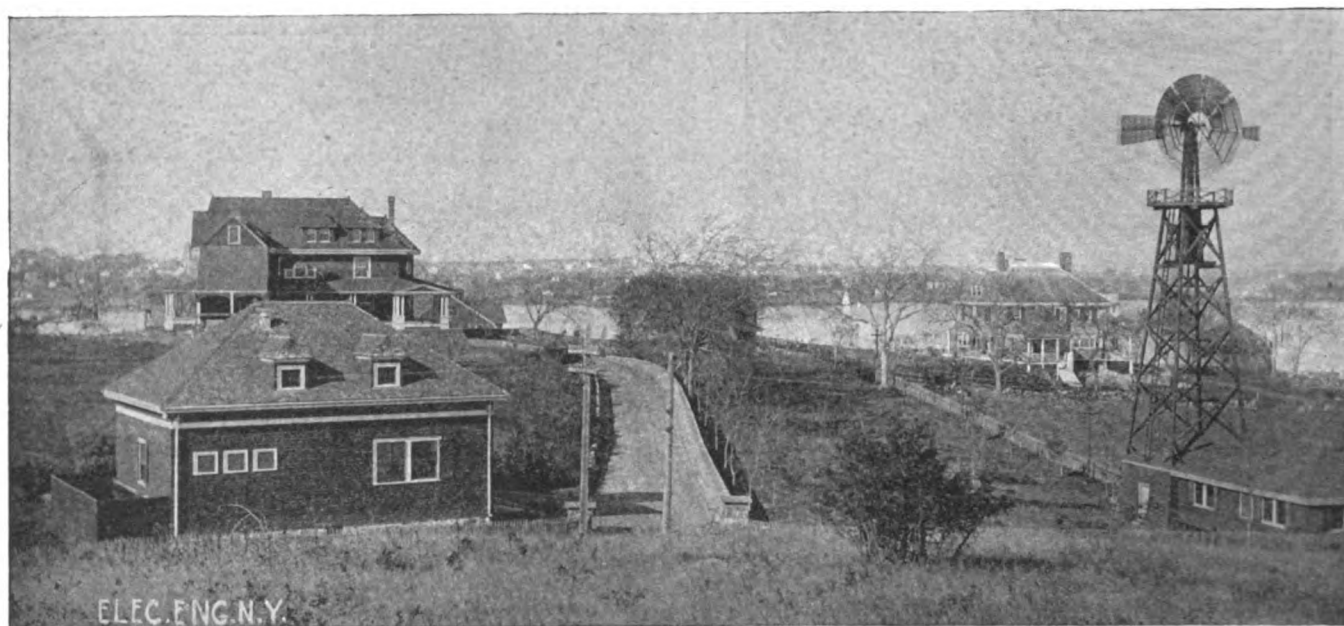
The desire by many owners of country houses to light them in a manner fairly comparable with that of their town-houses has brought forth an endless variety of methods involving gas in one form or another. But quite recently the matter has been approached from another standpoint, namely that of the windmill in connection with

the lights cost 1 cent per lamp hour exclusive of attendance, depreciation, and interest on money invested. A Thomson recording wattmeter was used to record the output of the batteries. A man could have been hired to run the plant for \$2 per day for one day a week. The cost of light may seem high but it must be remembered that the plant was elaborate for so few lights. By having batteries of larger capacity four houses could have been supplied with light. This plant was run winter and summer; in the winter the lights were used by the caretaker.

This spring Mr. McQuesten put in a wind-mill plant on the Lewis system to take the place of his steam plant. Our readers will recall the description of the Lewis system in our issue of Jan. 31, 1894. On May 1 the plant was completed and has worked well ever since.

At the same time that the wind-mill was installed a larger set of new batteries was put in so that another house could be supplied with current. The old batteries were in good condition when taken out.

The present plant illustrated in the accompanying engraving consists of a 20 ft. Eclipse wind-mill, mounted on a hard pine tower, 75 ft. to centre of wheel from



WINDMILL ELECTRIC LIGHTING PLANT AT MARBLEHEAD NECK, MASS.

the storage battery. In order to show that this method is not only practicable, but economical, not to mention its other advantages, we give a description of a windmill electric lighting plant erected by Mr. Geo. E. McQuesten of Boston, at the family country seat at Marblehead Neck, Mass.

There is no public system of lighting at Marblehead Neck, (a summer resort,) and hence private plants must be resorted to. In the spring of 1892 Mr. McQuesten put in a small electric light plant consisting of a boiler, 8 H. P. engine, 3 kw. dynamo and a set of 46 cells of storage battery, having 140 amp.-hour capacity. This plant was put in the stable and cost complete \$1,000. It supplied lights to the house and stable. The batteries were charged once a week either by the proprietor or by the gardener after he had been taught to run the plant. The necessity of economizing on the use of lights was felt, however, and so, except on especial occasions, not more than about 100 amp.-hours a week was used in the summer time. Late in the fall the batteries had to be charged twice a week.

During one summer (June to September) a record was kept of the cost of running the plant, and it was found that

ground and 60 ft. to platform. Power is transmitted by bevel gears and shafting to the house built at the base of the tower, which is 18 ft. 6 in. square at that point. The dynamo installed is a 2 kw. Lewis machine, but ought to be of 3 kw. as the mill develops more power than was anticipated. This charges the battery, consisting of 46 Bradbury-Stone storage cells of 200 ampere-hour capacity. Ninety-volt lamps are used, and an automatic switch closes the circuit between dynamo and storage batteries when the potential of the dynamo rises to 100 volts, and breaks the circuit when the current stops flowing into the batteries.

Our engraving shows on the left the house and stable of Mrs. McQuesten; the dwelling house on the right is owned by Gen'l. Elbert Wheeler, of Nashua, N. H. The house next to the wind-mill tower is Mr. Questen's workshop and contains tools and machinery of all kinds for experimental work. The house enclosed within the base of the tower contains the entire electric light plant as well as all the gardener's tools and implements.

The distance by line from the tower to one of the McQuesten mansions is 350 ft., to that of Gen'l. Wheeler, 225 ft. No. 4 B. & S. gauge is used for line wire, which

is specially heavy so as to have as little drop as possible on the line. The McQuesten house contains 60 lamps, and the other 50, the stable 15, and the workshop and tower about 12. During the shortest evenings about 40 lamp hours per evening were used all told. This was not very much, it is true, but was all that was needed. The amount increased gradually until on Nov. 1, 90 lamp-hours per evening were consumed.

At times when there was plenty of wind the shop was run by an electric motor from the batteries and in October the motor was used altogether whenever the shop was run. The steam plant is still there but has not been used since the windmill plant was erected.

The windmill furnished all the above lights from May 1 to Nov. 5, when the houses were closed for the winter. A 10 mile breeze gives from 3 to 5 amperes at 110 volts, while a 20 mile wind gives 18 to 25 amperes at 110 to 112 volts and would give much more if the dynamo were larger. It has not been possible to store all the power developed in a 20 to 25 mile wind, so that no figures can be given on that point.

It will be remembered that the Lewis windmill charging dynamo is provided with a series coil on the field, wound differentially to the shunt, so that the machine delivers current at constant potential at variable speeds. Mr. McQuesten tried the experiment of cutting out the differential winding and running the dynamo as a simple shunt wound machine. It worked beautifully in light winds, for as the wind mill tried to speed up, the load would come on the dynamo and prevent the mill from going any faster. As long as the power of the wind-mill was limited this worked very well. But when a strong wind came, there was so much power in the wheel that the dynamo could not take care of all the power and so would have been injured if left running. The advantage of the differential winding is that it allows the dynamo to speed up without overloading it.

As to the cost of a plant similar to that just described, Mr. McQuesten estimates it at about \$1,500; but, as stated above, its capacity is greater than that actually installed owing to the low capacity of the dynamo.

It is worthy of note that not once during the entire summer was the current interrupted owing to lack of wind. With this record there ought to be no hesitation on this score in equipping country houses along the coast with windmill electric lighting plants.

ELECTRICAL MACHINIST PRACTICE.—X.

BY

James F. Hobart,

JOURNAL fitting is a very important part of motor and generator construction, and provision for proper lubrication must be one of the first things made. There are various schemes, devices and "kinks" in use to secure a proper distribution of oil, among which may be mentioned the cavity filled with wicking; the oil channel in box lining; and the perforated lining. The journal bearing with a portion of the bearing cored out and filled with some form of fibre to hold, and convey the oil, is not a desirable method of lubrication for dynamo electrical machinery. Such a device may do well on line shafting, railroad cars, on heavy, slow moving machinery, but it has no place in electro-mechanical engineering. Even a line shaft is better off with some other form of lubricating device.

The preforated lining seems to be, theoretically, the perfect way of securing lubrication, but in practice it is not a desirable method. In the first place it is very expensive. To cast a bearing with perforations is easy enough, but the coring out, or drilling of the connecting

ducts, is where the cost comes in. Once procure the casting, with the necessary ducts and channels, and it is easy and simple enough to plug the radial holes with pine or fibre to arrange them all to touch the babbitting arbor, and to remove them after the casting of the soft metal lining has been done.

But to keep the perforated lining bearing in good order is another thing altogether. The perforations will fill up with dirt, gum up with oil, or become plugged with iron which has been worn off of the journal bearing in minute particles. The distribution of the oil in a perforated lining bearing is very good, owing to the large number of points from which the oil is applied. In practice, the spiral oil channel comes the nearest to the many perforations, and as the channel is very cheap, does not fill up easily and is easily cleaned when it does become clogged, it is, therefore, a very desirable way of lubricating a bearing.

Fig. 37 represents a view of one half of a box with soft metal lining. The drawing is not intended to be taken as representing the best practice in brasses, but merely to show the channels and their production. The engraving happens to show a top, or cap brass; therefore all the channels lead into the space *f* which may be used as a grease cup and be supplied with Albany grease for use in

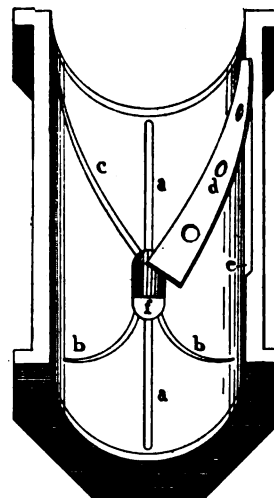
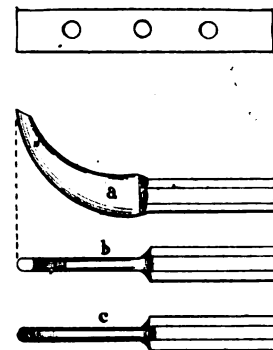


FIG. 37.



FIGS. 38 AND 39.

the time of possible trouble by heating. In the lower half of the box, the spiral channels may all run into a shallow space left at *f*, or they may terminate directly in the long channel *a*.

The shape of these oil grooves may show endless variety according to the whim of their designer, but they must all be arranged in some manner so they may commence at the source of oil supply, and terminate near the farthest corners of the box lining. As stated in a previous paper, some dynamo and motor manufacturers cut the oil channels on a milling machine. It is comparatively easy to cut the long straight channel *a*, and to do this, an ordinary milling cutter is used, the brass being held in a jig which is in turn bolted to the milling machine table.

The spiral grooves may also be cut in a similar manner; the jig being so mounted that it causes the cutting tool to follow a path similar to *b* or *c*. But it is quite a slow job to mill out the grooves. It also takes considerable time to put them into the jig and take them out again, so that a good smart workman, with chisel and chipping hammer, can discount the milling machine in oil-channel cutting. To chip grooves by hand, they should first be laid out, and marked, so as to look well when finished. The bearing would probably run all right if the oil-channels were rough, crooked and ragged, but it certainly seems reasonable to expect that oil will flow better through a smooth, even

passage than it will through a rough, jagged and crooked hole. Therefore, take advantage of the possibility, and lay out the oil channels as shown at *d*, Fig. 37.

This tool *d* is merely a thin piece of spring brass, or steel, which is sprung into the box as shown, the three holes in the piece are for convenience in holding it while marking or scribing the line. The holes must not be large enough so that the piece will spring or bend badly beside the holes, but it must lie smooth and even upon the soft metal lining. Fig. 38, shows the "marking strip" more plainly in plan.

For cutting the channels, a cold chisel is used. The spiral grooves being best made by a peculiar tool shaped like that shown at *a*, Fig. 39. This tool is bent to a circle greater than the diameter of the bearing. The radius of the bend depending upon the diameter and length of the box to be operated upon. The exact degree of curvature necessary can be quickly determined by fitting a bit of wood or tin to one of the lines laid out by the marker, Fig. 38. The chisel is shown in side view at *a*, and in top view at *b*.

This tool may be used for cutting the straight grooves, *a*, *a*, Fig. 37, but it is better to have a straight, or nearly straight tool for that purpose, also for starting the spiral grooves. If they are to be started with the tool shown in Fig. 39, the force of the blow will be expended almost entirely upon the end of the tool just back of the cutting point. As soon, however, as this part of the tool gets a bearing in the groove already cut, then the force of the blow is transmitted along to the point. The further into the cut the tool is driven, the better and freer it works. The tool used for starting the spiral grooves may be quite straight, but the tool for cutting the straight grooves will do better if it is given a slight bend near the end, just sufficient to raise the body of the tool so it will clear the surface of the box.

Although I am an advocate of machinery, and not of hand labor, still there are certain things that had better be done by hand than by machine, as I see it done in some large shops. With a milling tool made for steel, but running in soft babbit metal, and at the rate of feed adapted to cutting steel or hard iron, it is not to be expected that very brilliant results will be obtained as far as speed, or rate of turning out work quickly, is concerned. Neither, under the circumstances, is it to be wondered at, that an ordinary machinist with the hand tool (Fig. 39), can discount the power machine, and cut grooves in two boxes to one by the machine; but it is so.

There are several methods in use for forming the grooves and channels *a*, *a*, *b*, *b*, *c* and *d*, Fig. 37, besides chipping or milling. For rough work, it answers very well to simply wind a large cord or string around the babbitting arbor. The cord will form the grooves, and it may be easily removed after the lining metal gets cold. Another way, and a much more mechanical one, is to have some grooves made in the babbitting arbor, and loose steel forms fitted therein. When the arbor is removed after pouring the box, the forms, or lugs remain in the box lining, and are afterwards separately removed, leaving the oil grooves or channels as smooth and perfect as if cut with a milling tool, and polished with emery paper.

When a box is to be cast solid, and grooves made therein, the method above described does not work very well, and resource is frequently had to the string method, the shaft being forcibly pulled out after pouring, and the string or cord pulled out afterwards. In some cases, the cord is made of some soft absorbent fibre, and left in the grooves to serve as an oil holder. I do not think it at all desirable to do so, as the cord soon becomes full of dirt, and for oil conducting purposes, it is no better than the solid metal. Pull out the cord, if cord must be used, and afterwards, smooth up the groove with a sharp tool, or with emery paper.

Pulling an arbor out of a whole box after babbitting, is

not as pleasant a job as might be, and to get rid of it, several forms of collapsing mandrels have been devised. One, made by the Thomson-Houston Company, was built in four parts, two sides, to pull out first, then a top, and a bottom piece. The side pieces that came out first, were driven towards the centre of the box (sidewise) and being thinner at the outside edge, soon found room enough to come out easily.

A V-shaped groove was cut in the ends of the four pieces, and a pair of heads were made to fit the V-grooves. A hole in the middle of each head admitted a bolt, which, when screwed up tight, held the form as rigid as if it were made from a single piece of steel. The lugs for producing the grooves, were made of round wire, and imbedded fully half way into the mandrel, so it would stay there without any further support while the box was being poured.

By whatever method a bearing is lined with soft metal, it should be fitted to the journal, either by boring, reaming, or scraping. The whole box should be swaged, by running a sort of burnishing tool over the lining, in order to expand it to fill the iron or brass. Or, the latter may be tinned, then heated nearly to the melting point of babbit, the bearing poured and the box permitted to shrink upon, and contract with, the lining. Any half box should be either heated in a similar manner, or it should be hammered after being poured when nearly or quite cold.

After such hammering, the bearing should be fitted by reaming or scraping, and the edges of the half box should in all cases be relieved to preclude any possibility of too tight a fit at that point. Indeed, some makers deem it good practice to cast the edge or lip of the half box against a form that will give a bevel as shown at *c*, Fig. 37. This provides another oil channel, and helps the distribution.

The old fashioned style of fitting with the scraper, and testing with red lead, is not followed as frequently as it should be when first class work is desired, the tendency of engineers being to trust entirely, or nearly so, to nicely reamed bearings, and well turned journal bearings,—hence the necessity of running electrical machinery slowly for a time "until it finds its bearings." If the bearings are found with the scraper, when the machine is constructed, there will be little or no need of fitting the bearings by preliminary running with slow speed and light load.

OBITUARY.

J. HOOD WRIGHT.

The death occurred suddenly last week of Mr. J. Hood Wright, of the firm of Drexel, Morgan & Co., and one of the best known bankers of New York City. Mr. Wright was also one of the first among American capitalists to become interested in the development of electric light and power, and his aid was rarely denied to any such enterprise of real merit.

At a meeting of the Board of Directors of the Edison Electric Illuminating Company of New York, held on Thursday, November 15, 1894, the following minute was ordered to be entered on the records of the Board and the officers were requested to have the minute engrossed and a copy sent to the family of their late associate, J. Hood Wright; and that it be published in the daily papers:

RESOLVED—That the Board of Directors of the Edison Electric Illuminating Company of New York desire to record their grief and their deep sense of loss, occasioned by the sudden death of their associate of many years, their friend and fellow director, J. Hood Wright, for some time past the senior active member of the Board. From the beginning of his relations with the Company, in 1882, as one of its Directors, this corporation, in common with many other to which his wide and commanding abilities have been given, has profited greatly from his clear foresight, his keen judgment, his alert vigor and his incisive and useful criticism—qualities which made him justly pre-eminent among the financiers of this City. The Directors recognize with sorrow that each one of them has lost a helpful colleague, and the Company a wise counselor, whose place cannot readily be filled. They desire especially to extend their sympathy to his immediate family and to those in close association with him in business life in a grief which must be the greater as the relations of daily life drew him closer to them.

The directors afterwards attended the funeral of Mr. Wright in a body. At the same meeting, they passed resolutions of regret on the death of Dr. Eugene Crowell, one of the oldest officers and stockholders of the company.

ELECTRIC TRANSPORTATION DEPARTMENT.

IS THERE A SOLUTION OF THE ELECTRIC CONDUIT RAILWAY PROBLEM?—II.

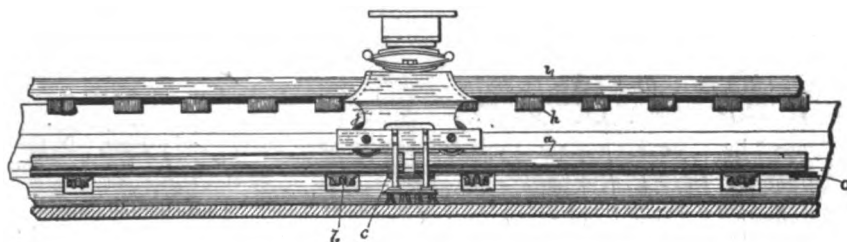
BY JOSEPH SACHS.

Now we come to another class or system in which the open conduit is used, but instead of having a continuous wire, a sectional conductor is used; that is, only a section of the contact conductor is connected with the supply wire and magnetic, electro-magnetic or mechanical switches may be used. We could,

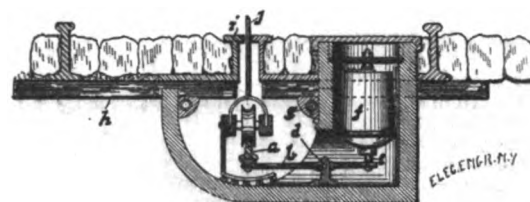
Coney Island, and is fundamentally due to Mr. G. T. Woods; it is practically the same as the Munsie-Coles but the very great advantage of this one is, that the switching mechanism, instead of moving up and down, moves on a pivot.

An experimental road was built at Coney Island, and from results published in a paper read before the American Institute of Electrical Engineers I consider it to possess a number of good points.

The Ashley is very much the same as the Lawrence system or



THE LAWRENCE CONDUIT.

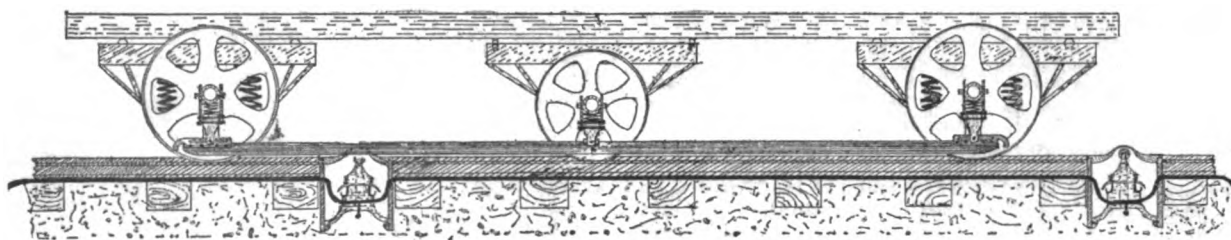


for instance, take any of the sectional conductor systems, and place the contact rail or plate within a slotted conduit. Various systems of this kind have been devised in which the sections of contact wire were operated by electro magnetic switches, such as the Wheelless and others.

The switching of the various sections, plates or contact points can however also be accomplished by mechanical devices operated

any of the sectional conductor systems operated mechanically. It consists of a conduit, a sectional flexible rail, and a supply conductor inside of a jacket. As the connector comes along it presses up a section of the conductor and throws it in connection with the supply wire.

These various forms of sectional conductor open-slot conduit systems possess, to my mind, very little advantage over the con-

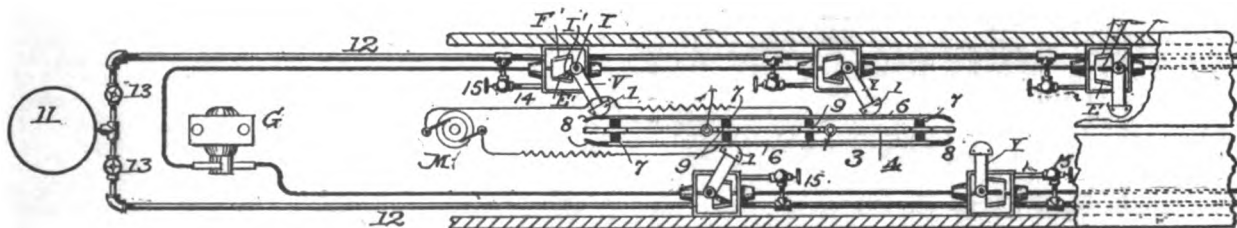


THE MUNSIE-COLES CONDUIT.

by the moving car. Many of these have been devised and tried. Thus in the Lawrence system a mechanical switch box is located at intervals, and the contact rail is composed of small T-rails supported on a pivoted lever, one end of which is connected with the switch piston. The trolley comes down upon the conductor, and by depressing one end of the lever supporting the rail, shoves up the other, and pushes in the switch rod, making connection with

tinuous wire conduit. You have the open conduit, the chance of getting mud, slush and dirt therein, and you have got to have a fairly large conduit.

Next, we come to a very peculiar system. Here the inventor, Mr. Mansfield, has attempted to bring the conductor, not in the conduit, not on the surface, but he has brought it above the surface. He constructs a slot parallel to the rail, and places



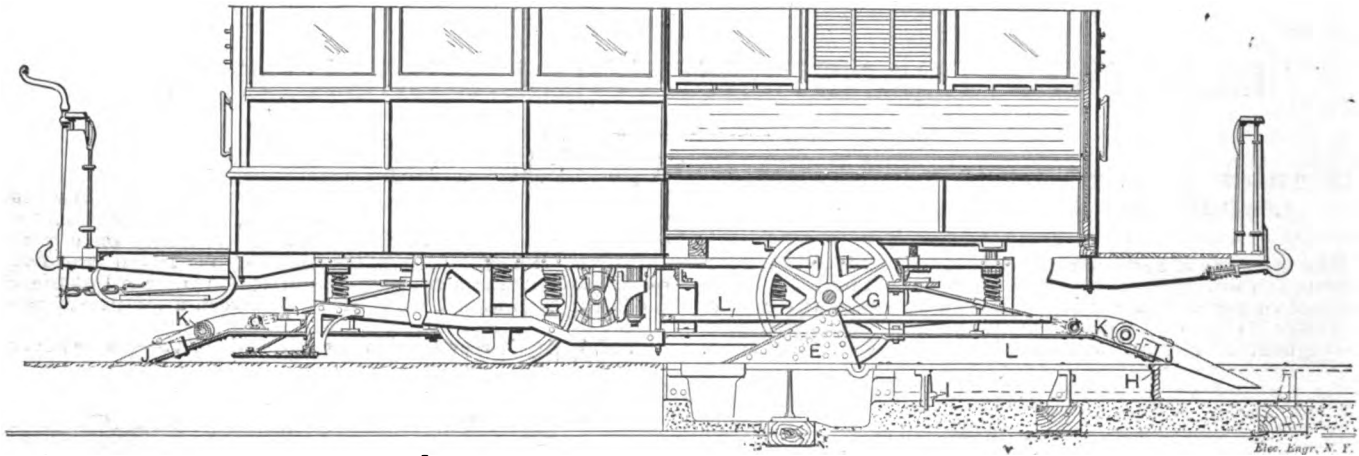
THE WOODS CONDUIT.

the main wire. After the collector has passed the bar springs up again, and connection is broken in the switch box for that section.

Another system of this type is the Munsie-Coles which was experimentally tried some time ago in New Haven, Conn. Instead of using a continuously depressed rail, a number of switch boxes are used and the contact points are depressed by a long plow on the car. The conduit is very small and simply covers up the boxes.

Still another system of this type was recently tried at

adjacent to the slot a number of switch boxes, having long arms, the contact points at the end of which run across the slot. On the car is a plow, which projects down into the slot, and also a similar plow at the other end, and a connection or contact bar between the two plows. The plow goes down in the slot, catches one of the arms and raises it up. While the lever is raised in connection with the bar current is supplied from that particular switch and then after the car has passed by the raised contact, the latter simply drops back again.



THE MANSFIELD CONDUIT.

In another form of raised sectional contact system, devised by Mr. Henry, the contact device is located in a box in the road-bed, and instead of having a mechanical device, there is an electro-magnetic device. A long magnet under the car attracts a plug in the box to it and makes contact therewith. After the car has passed, the plug drops back and out of connection. The raising and lowering of the plug causes it to be connected and disconnected with the supply wire.

Another form of raised contact system, has a slotted conduit, containing a flexible cable, which is supported on cross-bars. As the car goes along, it raises up the flexible cable out of the slot and over rollers under the car, and after the car has passed, the cable drops back.

We come now to another class, or system; in fact, a combination of systems which combine the magnetic arrangement of surface contact with the electro-magnetic. One of these is the Siemens system. Contact plates are used and the switching mechanism therein consists of a pivoted lever which is first attracted by the magnet on the car and after the plate has been connected the current passes around a coil of wire on the lever and magnetizes it as long as the current is taken from the plate. There is another system devised by Lieut. Patten in which practically the same method is adopted. The switching device is so arranged as to improve the magnetic circuit. A separate contact rail is used as the contact conductor.

Next we have what is perhaps the latest attempt in the surface contact system, the Johnson-Lundell system. It is very similar to the system I showed you previously, in which the magnetic switches are all grouped together. A sectional rail is used instead of contact plates.

This system possesses various points of interest. The peculiarities of this system are, that the car is also equipped with a storage battery, so that in case the brush under the car loses contact with any section of the contact rail, the car is simply operated by the storage battery. The battery is also used to actuate the magnetic switch if it should be de-energized. The inventors claim various advantages in combining the storage battery with a system of surface contact.

Various other surface contact systems have also been devised

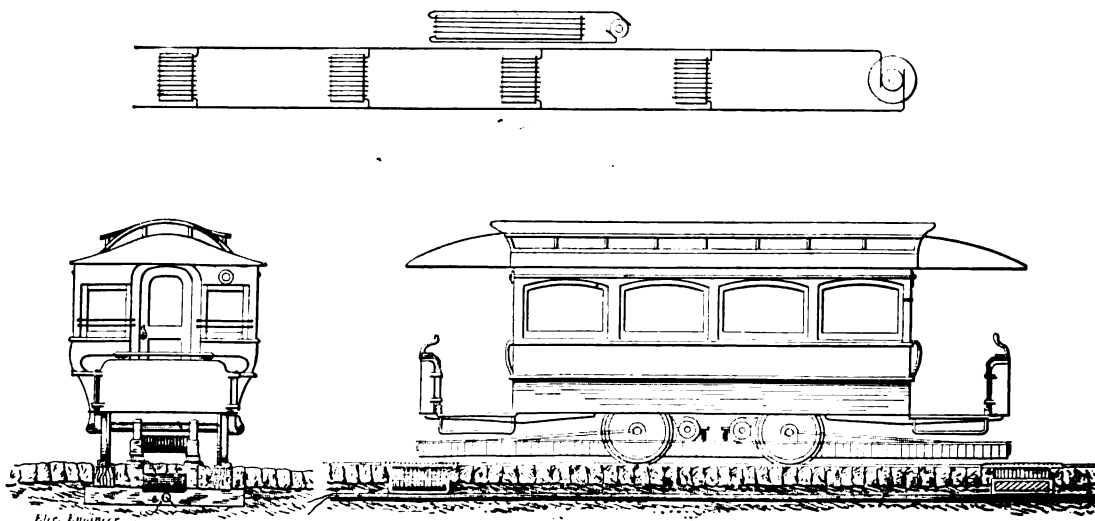
by Gordon, Pollak & Binswanger, Schuckert and others. In the last named system iron filings are used as the switching medium in the same way as the levers are used in one of the systems described.

Finally we come to what is called the induction system, in which a number of primary coils are located at regular points along the line, and upon the car is located a secondary coil, brought into such relation to the primary that a current is induced in the secondary from the primary. Although we may have the alternating current motor, the system would be very inefficient and costly. The Dewey system belongs to this class. The primaries are wound upon U shaped cores, imbedded in the road-bed with the two ends up. The long core on the car is also U-shaped; each end has a long brush which comes into intimate contact with the ends of the U in the street. The brush makes contact with one primary core before it leaves the last, and in that way a continuous alternating current is induced and the car is supposed to move; it has not as yet, though.

Perhaps, the first surface contact system installed in the country was that at Baltimore in 1885; the road was equipped with Daft motors; it had a T rail in the centre of the track supported by suitable insulators; 250 to 300 volts was employed.

Apparently nothing commercially practical has ever been evolved from any of the vast variety of material above enumerated except the plain, every-day, open conduit and the continuous wire. That simply means that it has many points of superiority because it is actually in operation and nothing else has ever been operated. We have such a system in operation at Buda-Pesth and at Blackpool, England; but it is doubtful whether either of these systems can be made operative in this country, owing to climatic and other conditions.

Various advantages are claimed for the different systems that have been suggested as a substitute for the open-slot conduit. They may obviate some of the disadvantages of the open-slot conduit with the continuous wire; they may claim to possess certain advantages in the way of costs and other considerations which are even less apparent than that of cost, but they have other very strong objections, which, I think, puts them far behind any open-slot conduit system, although I do not mean to say that

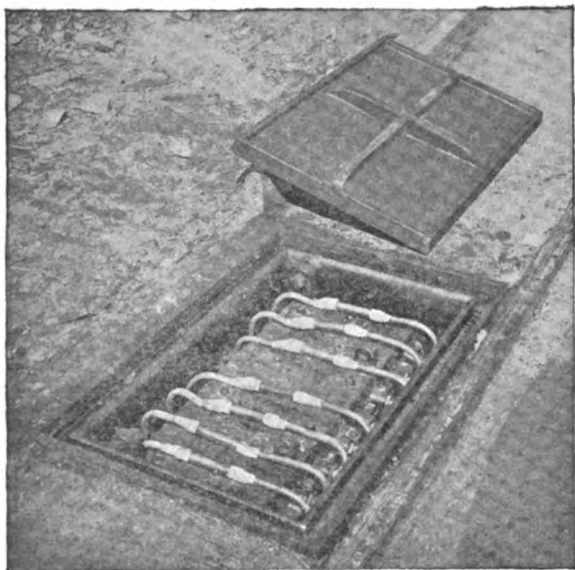


THE DEWEY INDUCTION SYSTEM.

such systems, that is, those other than the open-slot conduit, cannot be made operative.

Returning to the open-slot conduit systems, the aim has always been to produce a cheap system, which will compete with the trolley. That is a very desirable aim, but not one that is absolutely necessary, and from the fact that cable traction companies will put in cable systems where the track construction costs alone very nearly \$100,000 per mile, single track, as in New York, I think we can afford to spend quite a little on a conduit system which will operate as well as the cable system and certainly has various advantages which the cable has not. The problem is, primarily, one of mechanical construction of the conduit. We must get a large and a dry conduit; the voltage should be as low as the first cost of the plant will permit, in fact, below 800 volts if possible, and if possible we should use at a low voltage the structure as a return. I believe that these points can be met and that a system containing them can very readily be devised; in fact, Mr. C. H. Warner, an electrical engineer of New York, and myself, some time ago, attempted to attack that problem. We devised a form of conduit which has various points of advantage; we took the ordinary Broadway conduit, which you are all familiar with, and we got up an insulator which consisted of a central core of insulating materials, in which was imbedded a stud or bolt. On the core of insulating material were placed a number of petticoats of enamelled metal and separated from one another with a cup filled with oil at the bottom. This arrangement gives a very long leakage surface, namely, the inside and outside of each of the petticoats and the oil in the cups.

The main electrical point in the system is the voltage. If we



JOHNSON-LUNDELL SYSTEM.

can get the voltage low enough, we may put the conductor on the surface of the street, as Mr. Edison proposed some time ago.

If the Edison Illuminating Company can afford to spend millions in installing underground three wire feeders at 220 volts, for furnishing hundreds of horse power in lights, it certainly seems possible that electric railway companies whose dividends are just as high, if not much more so, could certainly afford to put in a system at the same voltage, or perhaps somewhat higher voltage, and perhaps in that way something successful may be done.

The alternating system also lends itself to this purpose. The author also mentioned the Leonard system intended for this purpose. The point is simply this; I do not think it is so much a question of building a system, but it is one which sounds very like this; what will it cost? The cost, it appears to me, is such that it will only insure adoption in our largest cities; but if we can build a system, I feel quite confident that it is wanted. I am borne out in that direction by eminent electrical engineers, in fact a number of companies who are putting down their good dollars to put in such a system certainly believe that way. The cost, to my mind, of a proper electric conduit will not be less than \$30,000 to \$40,000 per mile, single track, that is, including perhaps some cheap paving. This estimate however, is low and not for the best construction and assumes that there will be but very little obstruction, in the way of pipes, sewers, etc. But we must not compare this with the trolley; the trolley will reign supreme in its own field, and it has certainly been of enormous value in the ten short years of its life; and to say that at the coming of the conduit system the trolley goes out, is making a false prophecy, because the trolley has its own field and will

stay. The author then exhibited a drawing of the electric conduit to be installed in New York, illustrated in our last issue.

THE BUCKLEY ELECTRIC ELEVATOR.

ELEVATORS at the present moment are among the most essential adjuncts to a modern building, in short, without them these skyscraping structures would prove altogether impracticable. When the high speed hydraulic service was brought about, many found objections in being hoisted through the air so quickly, but now these same individuals cannot be hoisted quickly enough. Out of the many thousands of people riding up and down in elevators not one out of fifty ever stop to think what an immense industry elevator building has grown to be of late years; it is better

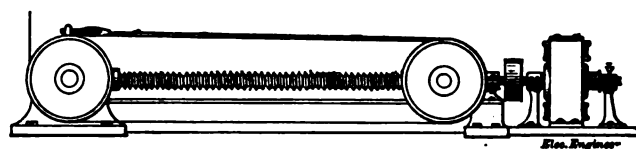


FIG. 1.—THE BUCKLEY ELECTRIC ELEVATOR.

estimated when stated that there are more elevators in the larger cities than there are street cars, and if rightly summed up not less than fifty million dollars will be found invested in elevators throughout the different sections of the country.

Some very unique designs in elevator machinery have already been brought forward, the most recent being the machine designed by Mr. J. P. Buckley which is now being constructed in this city. This machine is of the horizontal multiple sheave type, as shown in elevation in Fig. 1, and has an anti-friction nut through which a V-thread screw is revolved by an electric motor directly connected to one end. The main beam and end blocks

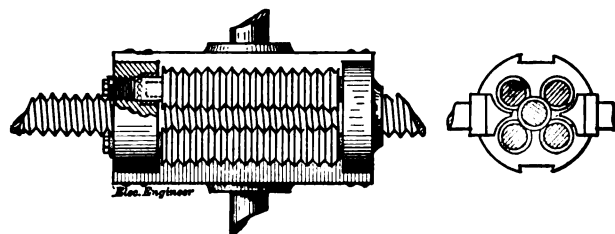


FIG. 2 AND 3.—THE BUCKLEY ELECTRIC ELEVATOR.

are specially cast, and support the screw nut, brake and a set of fixed sheaves at the lower end.

The more important feature of the device, however, is the hoisting nut which is composed of four annular grooved rollers so placed around the screw as to form a roller bearing shown in top view and section in Figs. 2 and 3. At the thrust end of the rollers the friction is overcome by the introduction of hard steel balls revolving between case-hardened plates of the roller and the housing. The device is simple in construction and is claimed to cost little to construct as well as to maintain in practice, and to be fifty per cent. cheaper than the hydraulic system.

FINANCIAL TROUBLES OF THE SUBURBAN TRACTION COMPANY.

The Suburban Traction Company of Orange is on the verge of going into the hands of a receiver, but is fighting hard to prevent a foreclosure of the mortgage held by the American Loan and Trust Company which secures the payment of the bonds outstanding to the amount of \$550,000. It is hoped by the management that they will be successful in their efforts to tide over their financial crisis.

The news of the company's condition leaked out when a meeting of its creditors was held and they were offered 50 cents on a dollar in payment of their claims. This is said to be the only terms upon which the stockholders will submit to a further assessment.

The Suburban Traction Company has been under heavy expense since it purchased the line between Orange and Bloomfield from the Orange Crosstown and Bloomfield Railway Company, nearly two years ago. The road was then run by horse power, and in Orange this was changed to electricity during the past year and the line extended to Eagle Rock. The Bloomfield Township Committee has just granted the company a franchise permitting it to operate its cars by electricity in that place, and until this was accomplished the managers did not expect to be able to clear expenses. The recent needless accident on the road on the Eagle Rock slope scared off a number of capitalists who were going to advance money for the road, and suits against the road for damages aggregating \$172,000 have been instituted. The floating debt of the company is \$149,000, about \$55,000 of which is unsecured.

THE ELECTRICAL ENGINEER.

[INCORPORATED]

PUBLISHED EVERY WEDNESDAY AT

203 Broadway, New York.

Telephone: 1323 Cortlandt.

Cable Address: LENGINEER.

Geo. M. Phelps, President.

F. R. COLVIN, Treas. and Business Manager.

Edited by

T. COMMERFORD MARTIN AND JOSEPH WETZLER.
Associate Editor: GEORGE B. MULDAUR.New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue,
Boston, Mass.Western Editor and Manager, C. KAMMEYER, 1439 Monadnock Building, Chicago,
Ill.New York Representative, 203 Broadway, { W. F. HANES.
Philadelphia Representative, 916 Betz Building, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada, - - - - - per annum, \$3.00
Four or more Copies, in Clubs (each) - - - - - 2.50
Great Britain and other Foreign Countries within the Postal Union " - - - - - 5.00
Single Copies, - - - - - .10
[Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1893.]

VOL. XVIII. NEW YORK, NOVEMBER 21, 1894. No. 842.

CONTENTS.

EDITORIALS:—	PAGE
Steam Elevated Roads are Doomed.....	418
"Where Are We At?".....	419
Another Gas Rival to the Incandescent Lamp.....	419
Electric Windmill Plants.....	419
New York Telephone Rates Again Reduced.....	419
ARTICLES:—	
The Electric Railway System of Toronto, Canada (illustr.).....	409
The Windmill Electric Lighting Plant at Marblehead Neck, Mass. (illustr.).....	412
Electrical Machinist Practice.—X. (illustr.).....	413
Electricity on Sulpboard.—L.....	430
Danger of Conductors in Bare Iron Pipes. (illustr.).....	425
OBITUARY:—	
J. Hood Wright.....	414
ELECTRIC TRANSPORTATION DEPARTMENT:—	
Is there a Solution of the Electric Conduit Railway Problem?—II. (illustr.) (concluded).....	415
The Buckley Electric Elevator. (illustr.).....	417
Financial Troubles of the Suburban Traction Co.....	417
NEWS AND NOTES:—	
Beacon V. P. & E. Co.—A Correction.....	419
The Telephone in War.....	421
Telephones for Government Service.....	421
Electricity for Milwaukee Bridges.....	421
Electric Juggling with Human Life.....	421
Electric Consolidation in Toledo, Ohio.....	424
New York Board of Electrical Control.....	424
PERSONAL:—	
Mr. Albert Ackerman.....	421
Mr. Abdank Abakanowicz.....	421
Mr. J. W. Parker.....	421
Mr. Ernst Thurnauer.....	421
LITERATURE:—	
Guy's "Electric Light and Power".....	423
LEGAL NOTES:—	
The Bate Case in the Supreme Court.....	423
Legality of a Trolley Franchise.....	423
R. S. Waring vs. George Westinghouse, Jr.....	423
Local Lamp Litigation.....	423
Chloride Accumulator Litigation.....	423
Edison Electric Light Co. vs. Davis Electrical Co.....	424
LETTERS TO THE EDITOR:—	
Water Power Governor Wanted.....	424
Storage Batteries and Gold Medals.....	424
SOCIETY AND CLUB NOTES:—	
A. I. E. E. News.....	424
New York Electrical Society.....	424
Association of Practical Electricians.....	424
REPORTS OF COMPANIES:—	
Edison Electric Illuminating Co., New York.....	424
INVENTORS' RECORD:—	
Classified Digest of U. S. Electrical Patents Issued November 6, 1894.....	425
TRADE NOTES AND NOVELTIES AND MECHANICAL DEPARTMENT:—	
G. E. Slow Speed, Four Pole Dynamos & Motors.—Tests of Magnesia Sectional Covering.....	426
The De Rycke Steam Separator (illustr.)—Combination Fixture Bids for Public Buildings.—Bids for a Pacific Cable.—The Chloride Accumulator Litigation.—Electrical Railway Material Wanted.—Philadelphia Notes.....	427
New England Notes.—Packard Lamps and Transformers.—Battery Supplies for the Government.....	428

STEAM ELEVATED ROADS ARE DOOMED.

THE publication, this week, of the financial reports of the Manhattan Railway Co. (elevated), and of the Third Avenue Railroad Co., which started up its cable road early during the present year, brings out facts that warrant the closest study by all engaged in street railway work, as they point unmistakably to a condition of affairs bearing directly on the future of street railways in general and elevated railroads in particular. Shortly after the Broadway and Third avenue cable roads were put in operation in New York it began to be commented on that they were drawing traffic from the elevated roads, but just to what extent was not positively known until this week, when the reports above alluded to were made public. From them we learn that the gross Elevated earnings for the year ending Sept. 30, showed gross earnings of \$10,138,143, a decrease of \$948,216, or nearly 10 per cent.! The operating expenses amounted to \$6,095,557, an increase of \$509,257; and net earnings were \$4,042,586, a decrease of \$1,457,473. The operating expenses, it is but fair to state, last year included taxes, which they did not cover in previous years. The percentage of operating expenses (including all taxes) to gross earnings was 60.12 per cent., against 53.90 in 1893. Comparing these figures with those of the Third avenue cable road, we find: Received from passengers, in 1894, \$2,007,804.83; in 1893, \$1,653,539; increase, \$354,265. Operating expenses, in 1894, \$1,070,965; in 1893, \$1,188,235; decrease, \$65,670. Net income in 1894, \$635,004; 1893, \$309,068; increase, \$325,936. Dividends, 1894, \$560,000; 1893, \$340,000; increase, \$320,000. These figures require little comment, but the lesson they point out will, we hope, not be lost upon the elevated railroad company. Lulled hitherto into a condition of lethargy, to say the least, by the absence of competition, they must recently have awakened to the fact that even the seemingly slow street car line when it gives the public all the advantages and comforts of well heated, lighted and ventilated cars mechanically propelled can become a dangerous rival. The results have been the same in Brooklyn, where the elevated has fought a losing battle with the trolley. As to the manner in which the elevated railroads propose to regain the ground lost, it seems to us that there is only one way, and that is, the equipment of their roads with electric motive power. We believe the company can afford to throw away its entire present locomotive equipment—each locomotive costing \$1,000 a year for repairs according to the figures of recent reports—and save money in operating expenses by erecting large generating plants and operating motor cars. The introduction of electric elevators at all stations would also remove an objection raised by many to the use of the elevated. The experience obtained with the Intramural Road at the World's Fair last year has settled that question once and for all, and the Liverpool road now running and the equipment of the Chicago Elevated Roads now in progress is a conclusive argument in proof of our assertions. The elevated roads in New York discharge an important function and will continue to do so in spite of all surface road or underground competition, and it would be a pity to see them fall short of their true value and become a burden instead of a source of profit to their stockholders. Let them adopt electricity and all may yet be well.

"WHERE ARE WE AT?"

Where are infringing lamp makers between last Saturday, November 17—when the Edison Canadian patent expired—and such time as the Supreme Court of the United States shall pronounce upon the interpretation of section 4887? Curiously enough, argument in the Bate case—which as our readers are aware involves the life period of several important electrical patents, including those of Mr. Edison for his incandescent lamp and his carbon telephone transmitter—was in progress before the Supreme Court on the very last day of life of the lamp patent, according to existing interpretation of law by the Circuit Courts, and when the transmitter patent had been dead two years and a half—that is to say, was still-born in May, 1892, under the same ruling. The Court is not likely to announce a decision in less than two or three months; meantime the lamp patent may be said to be in a state of suspended animation and the telephone patent to be awaiting resurrection.

It is not worth while to predict the action of juries or courts; but it may safely be said that very cogent reasoning will be required to induce the Supreme Court to reverse a well established doctrine of the Circuit Courts. It will be noticed [See *Legal Notes*, p. 423] that eminent counsel appeared or filed briefs for The Bell Telephone Co. and other electrical companies.

ANOTHER GAS RIVAL TO THE INCANDESCENT LAMP.

That the electric furnace should afford a product employed in the manufacture of an illuminating gas designed to compete with the electric incandescent lamp, is a result which even the most imaginative of prophets would scarcely have predicted; yet such, it would seem, is the latest development now attracting the attention of those interested in light distribution. The great illuminating power of acetylene has long been known but until recently no method was forthcoming by which it could be manufactured cheaply enough to compete with the enriched water gas which has been rapidly displacing coal gas, at least in this country. In prosecuting his work in the reduction of refractory oxides at his aluminum works, Mr. Thomas L. Willson found that large quantities of calcium carbide could be produced commercially from which acetylene is readily obtained. We have been afforded the opportunity of witnessing in operation a small plant for the manufacture of the gas and also of observing the flame which it produces. As to its brilliancy and steadiness there can be no question, and it is claimed that a burner taking 1 to 1½ cub. ft. of acetylene per hour affords an illumination equivalent to about 50 c. p. This is certainly a remarkable showing and we do not wonder that our gas friends are much elated at the prospect. We are not as yet in possession of figures as to the cost of manufacture of the gas, but we are told that it can readily compete with the present cost of the latter. We have no fear that this new departure in gas manufacture will materially influence the future status of incandescent lighting. Illumination by gas will always carry with it the old objections, the absence of which has given the incandescent lamp its present established position in so short a space of time, and in spite of the most strenuous opposition of the gas men. It is such periodical improvements in gas manu-

facture or methods of use that will act as further stimulants, first, to the manufacturers of incandescent lamps to turn out a product of increased illuminating power per watt consumed and, secondly, to the many now concentrating their energies on the production of the ideal light without heat. While thus unable to discern any danger to electric lighting interests in the new light it would be futile to deny its usefulness in many situations, more particularly in houses which cannot be reached by the present systems of electric illumination. There is here alone a field which will keep many electric furnaces going, requiring thousands of horse-power for the production of the material necessary for the generation of the acetylene gas. Indeed, if the hopes of the inventor are realized, the electric machinery necessary for the equipment of the furnaces will equal, if not exceed, in extent that which the electric railway has called for during the past few years. We shall await with interest the outcome of this decidedly novel departure.

ELECTRIC WINDMILL PLANTS.

The utilization of what are termed the waste forces in nature, such as waterfalls, the tides and the winds has formed the theme of many an interesting essay and given rise to much speculation as to the status of mankind when those forces will all have become subservient to human uses,—in other words when they will be applied to drive machinery. The waterfalls in harness are rapidly increasing in number, thanks to the dynamo and the electric motor, but the winds and tides are still to all intents and purposes running to waste. The windmill storage battery plant, however, holds out such immediate promise of successful application that it is strange that it has not been taken up more seriously, and that it has thus far been left almost exclusively in the hands of enthusiastic amateurs. Just what a windmill can do, however, is well brought out in the description which we give in this issue of such a plant installed on the Massachusetts coast. When, as is there shown, a current was available for lighting two houses amply for months at a time without a break, it would seem to be high season for the business man to take up the subject and to benefit by the pioneer work of the amateur. We are convinced that a systematic attempt in this direction will result in a commercial development which will well repay the time and trouble spent upon it.

NEW YORK TELEPHONE RATES AGAIN REDUCED.

The Metropolitan Telephone and Telegraph Co. have announced a further reduction of minimum charges for service. A subscriber requiring relatively small service may now, on a "two-party" line, obtain a minimum rate of \$80 per year. This is another example of the policy, long pursued, but not always adequately recognized by the public, of meeting service demands by equitable charges, and of making the charges as low as can be justified by reasonable estimates of the cost and of the value of the requirements.

BEACON V. P. & E. CO.—A CORRECTION.

The Beacon Vacuum Pump and Electrical Co. desire to correct the statement made in their circular postal card of November 18 that Judge Lacombe had restrained Bloomingdale Bros. of New York "from using Buckeye, DeKhotinsky and Novak incandescent lamps." The restraint as to Buckeye lamps relates to those purchased direct from the Buckeye Co., or otherwise than through certain authorized channels. The Beacon Co. were misled by an erroneous report of the decision in the newspapers. [See abstract of opinion under *Legal Notes*.]

ELECTRICITY ON SHIPBOARD.—I.¹

BY S. DANA GREENE.

I.—PRESENT POSITION.

The author first spoke of the enormous increase in the practical applications of electricity on land, and stated that on shipboard it had at last been recognized as the proper agency for lighting, though it has not been very largely introduced for other purposes. However, as all other applications are dependent upon the lighting plant, it is natural that the best engineering skill has been devoted to the latter. Special apparatus has sprung up for marine use, because special conditions have to be met, and a special class of what may be called "marine electricians" has been evolved.

On war vessels the plant is properly considered as one of the vitals of the ship, and is always located below the protective deck, in a compartment by itself, near the boilers and as near the centre of the ship as possible. In some merchant vessels and yachts the plant is located in the main engine room, to save expense in piping and in extra supervision and attendance. The presence of moisture, live steam or flying oil in the main engine room, however, is very injurious to electrical apparatus, and where possible the plant should always be located in a compartment by itself, as in the war vessels.

Engine and dynamo should always be direct coupled. The best practice is to provide a fixed coupling, readily accessible, between dynamo and engine. A reserve capacity should always be provided, if space allows. In the Navy, the present practice seems to provide a reserve of from 25 per cent. to 33½ per cent. of the full load duty of the plant, a separate unit furnishing the reserve. Thus, the full load service of the "New York" requires about 85 H. P. dynamo capacity which is supplied by two units, while a third, of 21 H. P., furnishes the reserve.

Engines should be of the open type, compact and strong, with rigid frames, large bearing surfaces and liberal clearance in the cylinders. Vertical engines occupy much less deck space than horizontal and are better adapted for ship service. The multipolar type of dynamo should be used, since it permits slow armature speed, less weight, greater compactness and closed magnetic circuit. Dynamos should be compound wound, insuring automatic regulation of the electromotive force with change of load, and should be provided with a field rheostat to compensate for the change in the resistance of the field winding, when hot or cold. Armature and fields should be most carefully insulated, and the insulation resistance of both should be carefully tested before the plant is accepted; it should not be less than one megohm. The maximum rise in temperature above the surrounding air (measured immediately after a full load test of not less than four hours) allowed in any part of the dynamo must be small, for high internal heat is certain to impair or ruin the insulation in time, and then the plant is useless without extensive repairs. The Naval specifications are very rigid in this respect, the maximum temperature rise being only 50° F. This makes the dynamos expensive, and a limit of 60° to 70° F. can be allowed with reasonable safety in the merchant marine, unless the location of a plant is particularly unfavorable as to temperature and ventilation.

Dynamos and engines should always be tested together, as a complete unit. The full load efficiency of the unit, as measured by the ratio $\frac{\text{Electrical H. P. at dynamo terminals}}{\text{Indicated H. P. of engine}}$ should be not

less than 80 per cent.; with the best types of marine sets it runs as high as 83 per cent. to 85 per cent. This applies to a unit with simple engine. The curve of efficiency falls off at light load, the efficiency being about 75 per cent. at ¼ load, 70 per cent at ½ load, and 55 per cent. at ¾ load, and it should be arranged, therefore, that the units in operation at light loads should be loaded to at least 75 per cent. of the capacity.

The switchboard is an important accessory of the dynamo room and, in common with all other appliances and devices used aboard ship, should be made of non-combustible material. The instruments and connections on the board should be accessible and compactly arranged and the positive and negative connections should be symmetrical. Any dynamo should be able to operate on any circuit, either single or in multiple with the other dynamos. Switches for different dynamos and circuits should be plainly marked so that the operator cannot make a mistake in their manipulation.

The wiring of a vessel is the most difficult and expensive, as well as the most important part of the installation. In Europe it was the practice for several years to use the single conductor system of wiring, where one conductor only is run from the dynamo to the lamps, the hull of the vessel being utilized as the return conductor. The practice, however, has never found favor in this country, and it has a number of serious faults, with the single argument of cheapness in its favor. Recent practice abroad does not favor it, and the system generally used is the two-conductor, insulated metallic return system. The wiring should be divided in separate circuits, lights which are located in the same parts of

the ship and which are ordinarily used at the same time, being grouped on the same circuit. These several circuits are then carried back to the switchboard in the dynamo room where they are so connected that they can be independently controlled. In a merchant vessel lights in the engine and firerooms, cargo spaces, storerooms and quarters should be on separate circuits, the subdivision of circuits being varied to suit individual vessels. On all exposed decks and in boiler and engine rooms, cargo spaces, storerooms and passengers' steerage, standard navy watertight moldings and fittings (junction boxes, switches, etc.), should be used. In the quarters of officers and cabin passengers, standard non-combustible fittings, such as are used on shore can be safely used.

The present standard navy wire has no lead covering. It was formerly required as a mechanical protection and water-proof covering of the wire, but it was found that in handling the wire aboard ship, the lead covering was very apt to become broken. The insulation of the wire should be depended upon to prevent troubles (the best rubber covered wire only being used) and a good heavy braiding affords all the mechanical protection needed, besides the molding. The loss in the wiring should not exceed 5 per cent. and the expense is not excessive if this loss is limited to 8 per cent.

The electro-motive force of all U. S. Naval plants is 80 volts. This standard has been adopted in order to permit the use of search lights and incandescent lamps on the same dynamos without the interposition of too much dead resistance in the search light circuit; and as the search lights are an important part of the military equipment of a naval vessel, the adoption of a non-commercial voltage for the plant may be justified. But in merchant vessels no such important reason exists, and the voltage should range from 100 to 120 volts, so that commercial incandescent lamps can be used.

All wiring fittings and fixtures should be of bronze, or composition with bronze finish, no iron being used.

II.—FUTURE DEVELOPMENT.

The use of the electric motor is probably the most important development to be looked for aboard ship. For military purposes, they can be used to advantage. 1. For ammunition hoists. 2. For handling the turrets of battleships and monitors and also the heavy guns in these turrets. 3. For torpedo discharge apparatus. For general purposes electric motors can be used to advantage for 1. Ventilating blowers. 2. Portable drills. 3. Portable pumps. 4. Operating machinery in engineer's machine shop. 5. Deck hoists, which are located at some distance from the boilers. 6. Operating valve of steam steering engine, and thus doing away with the long and awkward mechanical connection between steering wheel and rudder. The writer is of the opinion that a motor will eventually replace the steam steering engine itself. It requires about 15 H. P. only, and the application can be made successful. 7. Opening and closing of water-tight doors. This application is simple, and would greatly facilitate the prompt closing of doors in an emergency, either from the bridge or from any other desired point. If the water-tight doors of the ill-fated "Victoria" had been thus equipped, they could have been closed within the sixty seconds immediately preceding the collision (when the order to close doors was given) and the ship might have been saved.² 8. Driving ice machinery.

Search lights have been in use on war vessels for several years but their use as an aid to navigation is recent. There are however, many valuable uses to which they may be put by intelligent captains.

There are two general types; those controlled by hand, and those controlled by electric motors. The projectors should be placed well above the level of rails, guns, boats, etc., and in such a position as to command the greatest uninterrupted sweep around the horizon.

An instrument which will indicate quickly and with reasonable accuracy, the distance of objects within the range of vision at sea, is obviously of great advantage, both on account of its military value to a war vessel and as an aid to navigation in coasting or making land. Several range finders have been devised both here and abroad, but by far the most complete apparatus is that invented by Lieutenant Bradley A. Fiske, U. S. Navy.

The instrument is accurate and easily kept in order. In its construction, the principle of the well known Wheatstone bridge is applied very cleverly. Two standards are firmly secured to the deck, at the ends of a base line of known length. The standards are connected to each other and to a central point (usually the conning tower) by proper wires, there being also a telephonic connection between all these stations. Each standard carries a telescope, fitted with an electric contact and pivoted so as to travel over a graduated metallic arc. The galvanometer in the circuit is located at one of the standards. As the telescopes are directed on the same object, (communication being constantly maintained between the two stations by telephone) they take different positions on the arcs, and a deflection is produced on the galvanometer, which deflection is proportional to the distance

1. Abstract of a Paper read before the Society of Naval Architects and Marine Engineers, New York City, Nov. 15 and 16, 1894.

2. Captain Bourke testified before the Court of Inquiry that it required three minutes with a trained crew and under ordinary drill conditions, to close the doors of the "Victoria."

of the object. By trigonometry the distances are determined for different angular positions of the telescopes and the galvanometer is then graduated to read the distance direct in yards.

This distance is reported from the principal observing station to the conning tower by telephone and is then telegraphed to indicators placed conveniently about the decks. In future naval engagements, the range finder will play an important part and it may be a controlling factor in determining a victory; while in the field of navigation, its use will be steadily extended.³

A TRIBUTE TO SIR JOHN PENDER.

At the Hotel Metropole, in London, on Nov. 17, the representatives of the staffs of the Eastern, Eastern Extension, Direct United States, and Associated Telegraph Companies, over which Sir John Pender presides, presented him with a silver trophy to mark the twenty-fifth anniversary of the opening of cable communication with the far East, and to record their admiration of his labors in the cause of submarine telegraphy.

The design of the trophy is symbolical of the business of the companies in which the staffs presenting the testimonial are employed. The chief features are representations in miniature of the submarine cable and the steamship Great Eastern. On the plinth, and borne on the ocean waves, are four sea horses guided by tritons blowing trumpets formed of conch shells and supporting a large terrestrial globe, on which the various continents are accurately represented. A portrait of Sir John Pender, in high relief, is shown in front, while, surmounting the whole, Mercury is proclaiming the triumph of ocean telegraphy. The trophy was accompanied by a silver panel in a gilt casket. On this panel was an address. The casket is of novel and quaint design, being a large model of the submarine cable, with an opening at one end to receive the address.

THE TELEPHONE IN WAR.

Gen. Greely, chief of the signal service, in his annual report to the Secretary of War, makes interesting reference to the use of the telephone in modern warfare, with especial reference to the war now in progress in the East. "All late wars," he says, "and especially the one now waging between Japan and China, indicate that electrical connections are indispensable to the success of any army operating on a base apart from the general telegraphic system. Appreciating this fact, the work of the signal corps for the past few years has been given to experimental work in the equipment of its flying telegraphic lines, so that it may be ready for any possible emergency, and the system is so arranged that it looks to performing temporary telephonic service, whether between headquarters of a regiment and separate companies or an army and its different divisions, and whether such operations pertain to garrison, camp or actual conflict."

Gen. Greely records the marvellous success which has resulted from experiments in the army with the single uninsulated bimetallic wire lying on the ground in wet grass, when a whispered conversation was conducted through telephones half a mile apart. When the wire was partially buried the telephone could not be held close to the ear without discomfort. As showing the danger of reducing appropriations for the Signal Corps he cites the significant instance in the current accounts of the present Korean war, where it was mentioned incidentally that the day following the battle of Ping Yang the Japanese Signal and Telegraph Corps ran into that city a flying telegraph line extending from Seoul, a distance of seventy miles. The experiences of the army of the United States last year showed that several military departments had to be stripped of their signal sergeants and telegraph material to enable a similar length of line to be constructed in the valley of the Rio Grande.

The signal corps is already experimenting with a great military balloon, which has had many successful ascensions, and General Greeley's corps has endeavored to keep advised as to practical advance in the construction of dirigible balloons and aeroplanes, but nothing has developed during the year that points to the speedy solution of air navigation.

"The experiences of the past year," he says, "prove that the utility of the captive balloon is not confined to the open country, but on occasions it may be of supreme importance in connection with operations in the great cities. The great modern city, with its solid blocks of compact buildings extending for many miles, presents unusual facilities for speedy and undisturbed change of base on the part of bodies of lawless and riotous men engaged in committing depredations and in destroying property. The extreme difficulty of overcoming riotous bodies within the limits of a large city was strikingly exemplified in Paris by the Commune insurrection, where for weeks an inferior body of ill disciplined and poorly equipped men successfully resisted the most determined efforts of a superior force of regulars. Within the past year the troops of our own army, called upon to assist the civil authorities, found themselves marching miles of distance to repress riotous proceedings, while the body of men sought for had accomplished its end

and was already moving undisturbed and unobserved to another objective point. Under such conditions the operation of a captive balloon, provided with electric and telephonic connection with the commanding General, offer an unequalled means of observing and instantly reporting the movements of the hostile rioters, who would thus be under the surveillance of the commanding General, enabling him to act with promptness and effect."

TELEPHONES FOR GOVERNMENT SERVICE.

An interesting situation in regard to telephones for the government is developing in the departments in Washington. The question to be decided is one directly affecting the general use of instruments for governmental purposes. The various departments require interconnection and also some economical means of internal communication. It is claimed that the rates of the telephone company the licensee of the Bell Company, operated in Washington, and the well known fact that it will only rent and not sell apparatus, have so far prevented the adoption of a system in all the departments that would largely dispense with messengers and act as a decided lubricant to the ponderous wheels of routine.

The Interior Department has taken the initiative, and it will soon be settled whether or not a reliable telephone system can be owned and operated outside of the Bell privilege. Bids were received and opened a month ago, but were all rejected on account of technicalities.

Hon. William H. Sims, Acting Secretary of the Interior, has extended invitations to the manufacturers of telephones to enter bids for the construction of a system connecting the Interior Department and all its bureaus before next spring. If this is successful, it is probable that the Government will adopt the telephone largely as a valuable aid to business in all its branches. The proposals above referred to are to be opened at the Department of the Interior at 8 o'clock, on Tuesday, December 18, 1894.

ELECTRICITY FOR MILWAUKEE BRIDGES.

The board of public works, Milwaukee, has decided to change the manner of operating the Oneida street bridge across the Milwaukee river by putting in electricity. The Milwaukee Street Railway Company is now running cars across the bridge, and will supply the power gratis. Commissioner Schneider thinks that the Broadway bridge ought also to be operated by electricity. It would be necessary, however, to extend the cable from East Water street, which would cost a considerable amount. On this account City Engineer Benzenberg opposes the change to electricity.

ELECTRIC JUGGLING WITH HUMAN LIFE.

Dr. P. F. Gibbons, of Syracuse, N. Y., has applied to Gov. Flower for permission to experiment on a murderer, with the object of ascertaining whether criminals subjected to gerriocide actually die under the influence of the current or can be resuscitated. Gov. Flower appears willing to have the experiment made, but his exact powers in the matter are not quite clear. It is proposed that the person or persons subjected to the ordeal shall be treated with clemency should they survive the toasting, roasting and air pumping.

PERSONAL.

MR. ALBERT ACKERMAN late in charge of the lamp exhausting department of the General Electric Co.'s Lamp Works, at Harrison, N. J., has resigned.

MR. ABDANK ABAKANOWICZ, electrical engineer of the French Thomson-Houston Co., who is well known on this side of the water, we are informed, will soon pay us another visit to study the progress made since his last visit more than five years ago.

MR. JUSTUS W. PARKER, of J. W. Parker & Co., Philadelphia, agents of the Ball Engine Co., was married on Nov. 1 at Beverly, N. J., to Miss Georgie Adelin, eldest daughter of Councilman R. W. D. Albury. After the wedding, the happy pair left for a long tour in Canada and the North.

MR. ERNST THURNAUER of the French Thomson-Houston is again visiting the United States on business for his company. Mr. Thurnauer reports business very active on the Continent especially in electric railways which are gradually but surely forging ahead in the estimation of investors as well as of the public. The road recently opened at Havre with 50 cars and 13 kilometres of track was installed by the French Thomson-Houston Co., and it is expected that Lyons will soon follow suit.

³ An illustrated description of the Fiske range finder will be found in THE ELECTRICAL ENGINEER, Oct. 1, 1890.

LITERATURE.

Electric Light and Power. By Arthur F. Guy, A. M. I. E. E. London, 1894. Biggs & Co. 346 pp. 7x5. Illustrated. Price \$2 00.

It is not often that we have laid down a book of the character of the one before us with greater satisfaction than we have felt in the present instance. Not that the author has presented any strikingly novel features of the subject or advanced any new proposition, but he has certainly succeeded in marshalling his facts and figures in a manner which always keeps the attention of the reader alive and gives him the satisfaction,—which every reader prizes so highly,—of feeling that the author knew what he was writing about. The book is divided into a series of chapters, each of which treats of a prominent sub-division of the subject, but which in itself is more in the nature of an essay on the particular branch under consideration than a categorical presentation of the subject, and to that extent, therefore, is all the more digestible.

The opening chapter on the evolution of electrical engineering gives a very excellent résumé of the stages which have led up to the present state of the art, and, in particular, affords a good insight into the condition of electric lighting in London. Statistics which the author gives show that at the end of 1893 the number of incandescent lamps in use in London was 349,000 and that the demand for the current greatly exceeds the supply. To those who imagine that our English cousins are slow in the adoption of the light, or to appreciate its advantages, these figures will prove the contrary. Some interesting figures are also given as to the lighting of smaller towns and of the systems employed. Thus, out of 50 towns that possessed central stations at the end of 1893, 85 were the property of private companies, the remaining 15 being municipal plants. Of the same towns, 29 use the high pressure alternating system, 11 the three-wire low pressure, 1 the five-wire low pressure, and 9 the simple two-wire low pressure. As to the methods of driving the generators, it is also interesting to note that 15 stations are using ropes, 15 belts, and 19 direct driving. The tendency, however, in English central station work, is to have direct driving, high speed engines, coupled to low speed armatures, and the author believes that the indications are that American engineers will approve the English tendency in this direction, in which belief we fully concur. This variety of station work must eventually, of course, lead to the evolution of a system or systems, each best adapted for a particular condition, and the author believes that there will arrive a time when a consulting engineer will have to follow more or less well prescribed plans.

In this chapter the author also treats in a brief but lucid way the advantages of the electric light and more particularly the cost of electricity as compared with that of gas. The results reached by the author, the correctness of which we have no cause for calling into question, are exceedingly interesting; so much so that we give the results of the tabulation as between the arc, incandescent lamp and the gas jet, the cost of gas being taken as equal to 100.

Illuminant.	Cost of 1 c. p. per hour.	Full c. p. per hour.	Ratio.
Arc lamp.....	.00655 or $\frac{1}{154}$ penny	For 480 c. p.—3 pence	51
Incandescent.....	.087 or $\frac{1}{11}$ " "	" 16 c. p.—1 penny	207
Gas jet.....	.018 or $\frac{1}{55}$ " "	" 14 c. p.—1 " "	100

From this it will be seen that the arc lamp costs only half as much as gas for equal candle power, while the cost of incandescent lamps figures out at more than twice that of gas. These figures are arrived at by placing the cost of gas at 3s. (75 cents) per thousand cubic feet, and electricity at $7\frac{1}{2}$ d. (14 $\frac{1}{2}$ cents) per thousand watt hours. Just how far the ratio above obtained would be modified for this country will be apparent when we consider that the average cost of gas in our large cities is nearly twice that charged in England, while in the smaller towns it is not infrequently four or more times this amount. On the other hand, our cost per thousand watt hours is somewhat higher than the figure given for England, being in the neighborhood of 20 cents per thousand kilowatt hours for the larger cities. Taking the American figures and applying them to the case it will be seen that instead of incandescent lighting costing more than twice that of gas, on the basis given, it would only figure out $1\frac{1}{2}$ times the cost, in the larger cities, while in smaller towns the difference will be in favor of electricity. This slight difference in favor of gas in the larger cities is so far outweighed by considerations of safety, convenience and sanitary advantages that the incandescent lamp must, of necessity, continue in its career of progress, and even the Welsbach, we are certain, will not prove a dangerous rival to it in the United States.

Under the title of "Motive Power," in Chapter II, the author discusses fuels and the running cost of engines of various types, including steam, gas and oil engines, as well as water power. We can heartily recommend this chapter for those who desire to obtain a correct insight into the various types of engines just enumerated.

The author goes just deeply enough into the subject to give the reader a correct perspective of the whole without entering into details of construction, which would only weary and be out of place in a work of this kind. Comparing the cost of motive power with steam or gas, the author arrives at the conclusion, already reached by many who have given this subject close study, that when running about 8,000 hours per annum the steam engine and gas engine are about on a level for the cost, and that as the running hours are shortened, so in proportion the cost of the gas engine becomes less than that of the steam engine. For small plants the gas engine has a most decided advantage, even for long hours, and for short hours it is only half the cost of steam; the author generalizes by stating that:

With engines of about 40 brake horse power running 8,000 hours, the cost for steam and gas are about equal;
As the power decreases, so gas will be less than steam;
As the power increases, so steam will be less than gas;
As the hours decrease, so gas will be less than steam;
As the hours increase, so steam will be less than gas.

Of course the figures here given are subject to the same modification as in the case of lighting, above mentioned, and will thus depend to no inconsiderable degree upon the relative cost of coal and gas, so that allowances will have to be made in individual cases, the figures given being based on the cost in England of these two forms of fuel. Another interesting comparison as between steam, gas and oil, made by the author, shows the cost of brake horse power per hour to be as follows: Steam, .32 d.; gas, .75 d., and oil, .86 d., coal being taken at 15 s. (\$3.75) per ton; gas, 2 s. 9 d. (68 cents) per thousand cubic feet, and oil, at $5\frac{1}{2}$ d. (11 cents) per gallon.

The practical laws of electricity and magnetism form the subject of Chapter III, in which there are presented, in a brief space, a description of the various sources of electricity, the various units, the calculation of resistance, and the various conductors, insulators, the magnetic properties of iron, etc.

Under the head of "Electric Machinery" we find descriptions of the method of generating current, field magnet and armature winding, and very interesting notes on the running of dynamos. We also find an excellent discussion of the cost of dynamo electric machinery and how it varies with the speed and other conditions adopted by the designer. A curve included in this part of the work shows the cost of dynamo electric machinery in England at the present time. The machines, the cost of which is computed, are of five different types, selected from five districts in England. From these curves we gather the interesting fact that the ring armature, two-pole, double magnetic circuit type of machine appears generally to be the most expensive and to increase in cost more rapidly than the other types of machines, being closely followed by the type having a drum armature with the single magnetic circuit. The one showing probably the lowest general average is that of the ring armature with single magnetic circuit. The average of the various prices of the machines above enumerated, taking as a basis a machine of 24 kilowatts, would be £150 (\$727.50), or £6 4 s. (\$30.07) per kilowatt. Beyond this point the decrease of cost per unit is very slight, if anything. Comparing the cost here given with that of American machines, it will be seen that our machines are far lower in cost, as contracts can be closed with any of the larger companies for machines at from \$15 to \$20 per kilowatt. Considering the cheapness, both of material and of labor, in England, it would be interesting to know to what causes are to be assigned this marked cheapness in American machines. The above refers to continuous current machines. As regards alternators, the author states that a 200 Kw. alternator, running at 400 revolutions per minute, including exciter, costs £1,400 (\$6,790.00); that is, at the rate of £7 (\$33.95) per unit. The author also enters into a short but pithy discussion of the output and weight of machines as dependent upon their speed, general design, etc., the results being embodied in a table, so that comparison is made easy.

The station manager who has an eye to getting the best work out of his apparatus, outside as well as inside the station, will find much to interest him in the chapter devoted to "Electric Arc and Incandescent Lighting." In this the author takes up the question of the illuminating power of arcs, the consumption of carbon, the diffusion of light to order to get the best results, the hanging and trimming of lamps, town lighting, incandescent lighting, and the life and efficiency of lamps. He shows by tables and diagrams the best method of suspending arc lamps and the areas which they will illuminate most effectively, and gives various devices employed to obtain the best results. Among these we notice that the City of London Electric Light Company use a lantern having panes of ribbed prismatic glass, by which the arc light is greatly magnified and softened down, so that the light rays are well diffused.

Having been imbued with the idea that gas is so cheap in England we are hardly prepared to be told that in England it is very seldom that one comes across a town that is decently lighted by gas, and even then it is confined to the few important streets. Considering this condition of affairs it is, if anything, occasion for additional wonder at the slow progress which electric lighting had until recently made in English towns.

In discussing the most economical method of obtaining the highest efficiency in incandescent lamps, and taking into consideration both the cost of renewals and the cost of current, the author gives a table based on the lamp life experiments of Siemens & Halske, showing the total cost of one candle power per hour, as compared with the price of the current energy for five lamps run at different efficiencies.

A final chapter on the "Distribution of Electric Power" by the various systems, alternate current working, transformers, together with some notes on traction and the cost of electric energy, serves to round out the work.

From what has been said above it will be apparent that the electrical engineer will find here much that comes within the province of his daily work, and the information given, if carefully analyzed and applied, cannot fail to yield valuable results to all engaged in electrical distribution of whatever kind. The book, we are glad to say, is not burdened with illustrations of apparatus with which every one who keeps au courant with the progress of the art is perfectly familiar, and the few diagrams and sketches which are scattered through the work are clear and suffice thoroughly for the needs of the reader. The work ought to be in the hands of every electrical engineer and station manager.

LEGAL NOTES.

THE BATE CASE IN THE SUPREME COURT. FATE OF IMPORTANT ELECTRICAL PATENTS AT STAKE.

Readers of *THE ELECTRICAL ENGINEER* are doubtless familiar with the scope of this case, and are aware that its determination will close the question—so interesting to lamp manufacturers—as to the status of the Edison lamp patent after November 17, 1894 (last Saturday) when the Canadian patent expired, under section 4887, Revised Statutes, U. S. [see *THE ELECTRICAL ENGINEER*, No. 291, November 29, 1893, p. 478.] It will also affect the terms of other electrical patents—notably the Edison Carbon telephone transmitter patents.

Having been sent up to the United States Supreme Court by the Circuit Court of Appeals the case has been under argument at Washington for some days, distinguished counsel appearing in the interest of electrical concerns likely to be affected. Argument was begun on Thursday, November 15, by C. E. Mitchell, Esq., ex-Commissioner of Patents, who appeared for the Bate Company, Wheeler H. Peckham, Esq., and Edmund Wetmore, Esq., followed for the defendants, and on Friday afternoon James C. Carter, Esq., began the closing argument for the Bate contention that the application dates rather than the issue dates of patents taken both in the United States and in a foreign country should control the application of section 4887 in limiting the life of an American patent by that of a foreign patent for the same invention. Mr. Carter had not finished his address at the close of court on Friday and was given permission to conclude his argument on Monday November 19.

The importance of the Bate case to many corporations and individuals concerned about property in patents is manifested by the appearance in court of J. J. Storrow, Esq., for the Bell Telephone Company; Leonard E. Curtis, Esq., and Paul D. Cravath, Esq., for the Westinghouse Company; ex-Attorney General Bristow for the Harrison Telephone Co.; W. H. Kenyon, Esq., who filed a brief in support of the defendants; B. F. Lee, Esq., for the Chemical Rubber Co., and ex-Solicitor General Chas. H. Aldrich for Milo G. Kellogg. Mr. Aldrich was granted permission to fill a brief for his client.

LEGALITY OF A TROLLEY FRANCHISE AT ASBURY PARK, N. J. DISPUTED.

The Supreme Court of New Jersey has rendered a decision adverse to the Asbury Park and Belmar Street Railway Company, which runs its road through Asbury Park, Ocean Grove, Bradley Beach and Neptune City, terminating at Belmar. A year ago the Common Council of Neptune City granted a franchise to the company. Edward Batchelor, of Philadelphia, who owns \$1,000,000 worth of property in Neptune City, was opposed to the road. He claimed that the franchise was not granted legally, because a majority of the property owners along the line had not consented to the road being built. Mr. Batchelor carried the case to the Supreme Court. The decision, it is expected, will prevent the company from running its trolley cars. The company will carry the case to the Court of Errors and Appeals.

R. S. WARING vs. GEO. WESTINGHOUSE, JR.

On November 10, at Pittsburgh, Robert S. Waring filed a bill in equity against George Westinghouse, jr., asking that he be compelled to account for 10,000 shares of stock of the Standard Underground Cable Company. Waring owned a patent on the manufacture and insulation of electric wires and cables. In 1886

Mr. Westinghouse took 5,000 shares in the company and Waring said he was induced to place 10,000 shares in the name and control of Westinghouse. For this stock Waring says he has received no compensation or accounting and alleges that Mr. Westinghouse has sold the stock.

Mr. Westinghouse says that his answer to the bill will show fully and conclusively that its statements are unwarranted and contrary to all of the facts. Although the transactions referred to are over eight years old, Mr. Waring never intimated directly or indirectly until very recently that he was dissatisfied with his voluntary act or that he had any claim of any character. Mr. Waring was persistent in desiring Mr. Westinghouse's co-operation. Mr. Westinghouse found, after he became connected with the company, that it was practically bankrupt, and he was required to put in \$125,000, the only cash working capital the Company ever had; but since he was elected its president the Standard Underground Cable Company has become one of the most successful corporations in Pittsburgh. Mr. Westinghouse further says that the manner in which Mr. Waring had made his claim, and had distributed printed copies of his bill fully warranted the belief that it was an attempt to get some small consideration for nothing; that his refusal, as Mr. Waring put it "to make him a present," or in any manner to consider his unjust demand, was followed by a threat of a suit.

LOCAL LAMP LITIGATION—THE BLOOMINGDALE CASE IN NEW YORK.

In this suit—Edison Electric Light Company and The Edison Electric Illuminating Company of New York, vs. Lyman G. Bloomingdale and another—United States Circuit Court, Southern District of New York, Judge Lacombe rendered a decision November 12.

The defendants were using, on their premises in this City, incandescent lamps of three kinds, namely:—the Khotinsky, the Novak and the Buckeye. The first two of them were concededly infringements, and no opposition was made to the granting of a preliminary injunction restraining their further use. As to them an injunction order was granted by the Court.

In respect to the Buckeye lamps, in view of the decision of Judge Ricks, Northern District of Ohio in January last—refusing to continue a preliminary injunction against the manufacturers of the Buckeye lamps, and in view of subsequent agreements between the Edison Company and certain defendants, permitting the sale of Buckeye lamps by the latter—in Buffalo, N. Y.—Judge Lacombe denied an injunction against the use of Buckeye lamps by Bloomingdale, provided the defendants should stipulate "to file sworn monthly statements of all Buckeye lamps hereafter bought in the life-time of the patent and during the pendency of this suit (or until further order) to replace those now in use or to increase their lighting plant, showing from whom such lamps were purchased, so that complainants may, if so advised, move to restrain the use of any of them, which have not been sold out of the monopoly." In other words, Bloomingdale may continue to supply himself with Buckeye lamps if he purchase them from the parties in Buffalo who have acquired the right to sell them from the manufacturing licensee under the patent, but may not obtain them directly from the Buckeye company.

It is to be noted that Judge Lacombe declined to accept the contention of defendants, that the comity of the courts required him to adopt Judge Ricks's decision of January, holding the Buckeye Company free of the monopoly under the Edison patent [see *THE ELECTRICAL ENGINEER*, No. 300, January 31, 1894], deeming it the duty of the Court rather to follow the opinion of the Circuit Court of Appeals, Second Circuit, New York, in the case of Edison Electric Light Co. vs. United States Electric Lighting Co.—in which the precise point was argued. Judge Lacombe says: "The printed brief of counsel in that case epitomizes their argument thus: 'The Edison Company by its solemn statement to the Commissioner of Patents, duly verified by Mr. Edison, is estopped from saying that the term of the British patent has not become the measure of the duration of the American patent.' That Court, however, upon full argument and careful consideration held that the point taken was unsound, and sustained the decree of injunction and accounting."

The court has not yet entered a decree in the case, and it is understood that some contention is likely in respect to its terms. It was looked for Friday November 16, but its settlement was put over till the next following Friday.

CHLORIDE ACCUMULATOR LITIGATION.

A decision was rendered on Nov. 15 in the U. S. Court of Appeals for the Second Circuit, in the case of the Accumulator Company vs. The Edison Electric Illuminating Co. and The Electric Storage Battery Co., by Judge Wallace, affirming the decision of Judge Lacombe enjoining the Edison Electric Illuminating Company of New York from using the chloride battery, for the reason that it is an infringement of the Swan reissue patent.

EDISON ELECTRIC LIGHT CO. VS. DAVIS ELECTRICAL CO.

On Monday, November 19, the Davis Electrical Company, in the U. S. Circuit Court, District of Massachusetts, moved for a dissolution of the injunction against them on the ground of the expiration of the Edison lamp patent November 17, the end of the term of the Canadian patent for the same invention. His Honor, Judge Colt, denied the motion pending a decision in the Bate refrigerator case, now before the United States Supreme Court.

LETTERS TO THE EDITOR.

WATER POWER GOVERNOR WANTED.

We want to buy something in the way of an electric governor for use in our power plant in connection with our 500 volt electric railway. We operate by water power under 140 feet head and during the day time there is no other load and we find it hard to regulate speed with only one or two cars running.

We have in mind something in the way of iron wire resistance to be kept in the main circuit within the power house and to take say 200 amperes of current and this resistance to be automatically cut out and in as the demand from the railway varies. We have plenty of water and economy in this is no object. We would thus be able to keep an even load on the water wheels and dynamos.

We understand that there are devices of this kind in use in the country but do not know who makes them. If you can give us any light on the subject or will kindly forward this letter to the proper parties in case you happen to know them it will be very greatly appreciated.

ELECTRIC RAILWAY, LIGHT AND POWER CO.,

Per C. R. HOLMES.

ANACONDA, MONT., Nov. 4, 1894.

STORAGE BATTERIES AND GOLD MEDALS.

Under the above heading in THE ELECTRICAL ENGINEER of Oct. 31, Mr. R. Macrae makes some very pertinent remarks; such as have doubtless suggested themselves to many other engineers since the appearance of the recent gold medal advertisement of the Chloride battery.

One of the first of these advertisements appeared a few weeks ago in a Philadelphia newspaper in the form of a letter from a New York correspondent. This letter spoke in such glowing terms of the wonderful battery that had been discovered and was now absorbing the attention of the scientific world, that it created a very general popular interest in the matter. Many people really thought we were on the verge of an electrical revolution and that Philadelphia was to be its centre. The letter stated, among other things, that this wonderful battery was manufactured here and was used to supply the street cars and electric lights of Paris and that therefore "Philadelphia is lighting Paris." About this time Electric Storage stock advanced several points.

In view of the general interest that has been aroused in this prize medal would it not also be interesting to the public to know who the experts are that made these tests; who constituted the committee; how and by whom the committee was appointed; were the experts or any members of the committee or any of the officers of the Franklin Institute, through whom the committee was appointed, on the pay-roll of the Electric Storage Battery Company? The Franklin Institute will undoubtedly be very glad to furnish the public with this information in the interest of science.

W. A. ROBBINS.

PHILADELPHIA, PA., Nov. 8th, 1894.

SOCIETY AND CLUB NOTES.

A. I. E. E. NEWS.

The 91st meeting of the Institute, will be held at 12 West 31st street, New York City, on Wednesday, November 21st, at 8 P. M. A paper will be presented by Prof. George D. Shephardson, University of Minnesota, Minneapolis, entitled "Suggestions for an Index of Engineering Literature." An opportunity will also be offered for the discussion of the paper read by title at Philadelphia, by Mr. Charles P. Steinmetz, of Schenectady, and Dr. Frederick Bedell, of Ithaca, on "Reactance, and its Definition." A meeting of Western members will be held on the same evening, Wednesday, November 21st, 8 P. M., at Armour Institute, 33d street and Armour avenue, Chicago.

The office of the American Institute of Electrical Engineers, which has been at 12 West 31st street since May, 1890, has been removed to rooms 1009 and 1010 Havemeyer Building, 26 Cortlandt street, (10th floor), New York City. The inconvenience of the uptown location has long been apparent to officers and members in the city, as well as visitors from a distance.

The choice of the Havemeyer Building was due to its central location in the electrical district, and its convenience to various lines of travel. The office will be open from 9 A. M. to 5 P. M. It is equipped with a long-distance telephone, and district messenger service. Over 100 electrical, mechanical and engineering periodicals will be found on file.

The Institute meetings will be held at 12 West 31st street, as heretofore, until further notice.

NEW YORK ELECTRICAL SOCIETY.

The 168d meeting of the New York Electrical Society will be held at Columbia College, on Tuesday Nov. 27th, at 8 p. m., when a most interesting lecture will be delivered on the subject of: "Direct Current Motor and Dynamo Design," by Mr. Gano S. Dunn, electrical engineer of the Crocker-Wheeler Electric Co. Among other points in this lecture, special reference will be made to lighting and its effect on design; the newest forms of winding, such as two circuit, double, etc.; sparking and armature reaction. A method of making the increase of potential in a compound wound generator proportional to its load will be described, and many other hints and suggestions will be given of the utmost value to students and young electricians.

ASSOCIATION OF PRACTICAL ELECTRICIANS.

The Association of Practical Electricians was incorporated in Chicago last April and at the present time has 80 members. The praiseworthy object of the association, is the education and advancement of men engaged in electrical work, to a better knowledge of proper electrical installation and construction, with the assistance of an able corps of instructors. A course of lectures has been arranged with parallel readings and study.

The officers of the association are: Geo. E. Sanford, pres.; G. H. Jacob, Vice Pres.; J. L. Hagadorn, Rec'd. Sec'y.; G. H. Farrar, F. Sec'y.

REPORTS OF COMPANIES.

EDISON ELECTRIC ILLUMINATING CO. NEW YORK.

The following comparative statement of earnings is issued by Mr. Jos. Williams, Treasurer, Edison Electric Illuminating Co. of New York.

	October.	
	1894.	1893.
Gross.....	\$122,728.88	\$104,448.11
Net.....	60,527.40	56,254.30
		\$18,275.27 Inc.
		4273.10 Inc.
	Ten Months.	
	1894.	1893.
Gross.....	\$1,090,112.57	\$956,667.83
Net.....	568,491.98	441,124.45
		\$138,444.74 Inc.
		122,367.53 Inc.

ELECTRIC CONSOLIDATION IN TOLEDO, O.

It seems highly probable that all the electrical enterprises in Toledo, Ohio, will be combined under one management through the efforts of Messrs. Chas. A. Coffin, of the General Electric Company, and Norman P. Ream, of Chicago, principal owner of the consolidated company. The street railway systems of Toledo include 92 miles of track excellently equipped, and are operated at present by two companies; the Toledo Consolidated Street Railway Company and the Toledo Electric Street Railway Company. The common stock of these roads is \$1,500,000 and \$800,000, respectively, while their respective rating is \$3,000,000 and \$1,400,000, to include bonds and floating debt. The Toledo Electric Co., has a capital of \$200,000 and operates in round numbers, 900 arc and 8,000 incandescent lights, and the Western Electric Light & Power Co., with a capital of \$20,000, supplies about 500 arcs. These two companies are rated at \$350,000 and \$200,000, respectively, making the total capital involved in the proposed consolidation \$4,950,000.

It is said that the new company will have a capital of \$5,000,000, and that but two of the four central stations now in use will be retained; one for lighting and one for railway work. Either of the existing railway plants is capable of operating all the roads in the city, and the Toledo Electric Co.'s station on Water street has sufficient capacity to light a city of 500,000 inhabitants.

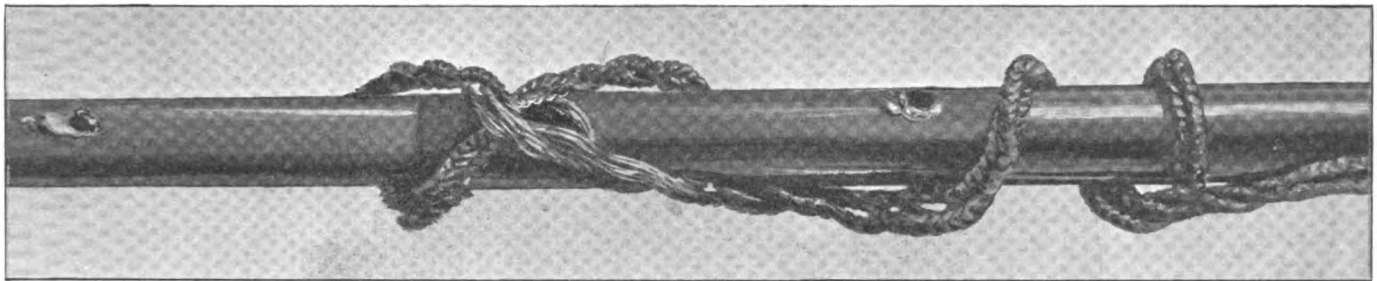
NEW YORK BOARD OF ELECTRICAL CONTROL.

There was a story in circulation last week to the effect that Mayor Gilroy had determined to appoint a new Board of Electrical Control that would meet with the approval of Mayor-elect Strong, and that it would consist of a Republican, a Tammany man, and an independent Democrat.

DANGER OF CONDUCTORS IN BARE IRON PIPES.

In a recent editorial discussing the question of conductors in iron pipes we vouchsafed the opinion that the greatest safety could only be reached by insulating the interior of such pipes by a suitable material. Experience had sufficiently demonstrated the necessity of such a safeguard, but it seemed necessary to point it out again in order to prevent the adoption of a method which would be a distinct backward step. In proof of what was then said we present an illustration, made from a photograph, showing the condition of an iron gas fixture pipe as the result of a short circuit on it, for which we are indebted to the *Architects' Electrical Bulletin*. This illustration is taken from "Characteristic Burnouts," published as a supplement to the fifth fire report of the Underwriters' International Electric Association, and is accompanied by the following comment: "Two 110 volt lamps in series on 220 volt circuit. Short circuit on gas fixture. 50 ampere fuse." The sheet is dated October 10, 1894, and signed by Mr. W. H. Merrill, Jr., for the Committee on Fires.

The genesis of this burnout, says the *Bulletin*, is easy to be discovered. The wire of the incandescent lamps was wound around the gas fixture stem. There was a short circuit on the stem in some way; the fuse did not blow; and in a very short



RESULT OF A SHORT CIRCUIT BETWEEN WIRES IN CONTACT WITH AN IRON PIPE.

time the heavy current had set up no fewer than three arcs between the wire and pipe, making the three bad holes. It is obvious that what had thus occurred outside the pipe would have happened just as quickly had the wires been inside.

INVENTORS' RECORD.**CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS
ISSUED NOVEMBER 6, 1894.****Accumulators:—**

Storage Battery, O. J. Reed, Philadelphia, Pa., 528,647. Filed June 5, 1894.
Employs a perforated envelope not readily attacked by the battery liquid, in combination with a negative electrode surrounding the positive electrode and the envelope.

Storage Battery, O. J. Reed, Philadelphia, Pa., 528,648. Filed June 8, 1894.

Claim 1 follows:
An accumulator or storage battery having its electrodes immersed in a solution of sulphuric acid and cadmium sulphate.

Secondary Battery, E. M. Poston, Springfield, Ohio, 528,740. Filed Jan. 22, 1894.

Employs a number of elements connected in series and included together in one casing so that the potential of the battery may be varied at will.

Alarms and Signals:—

Electric Burglar Alarm, W. A. Brownell, Boston, Mass., & J. B. Seager, Hancock, Mich., 528,589. Filed Jan. 31, 1894.

Railway Signaling System, M. Corrington, New York, 528,593. Filed Dec. 3, 1891.

An automatic electric block signal system for steam railways.

Circuit Closer, H. J. Hovey, Oak Park, Ill., 528,672. Filed Dec. 26, 1893.

A circuit closer for railway tracks operated by trains passing in one direction only.

Electric Leak Alarm, C. C. Kahne, A. A. Adkins, W. S. Pierce, J. E. Martin and G. F. Kahne, Ashland, Ky., 528,881. Filed July 6, 1894.

An automatic alarm adapted to give notice in case of leaks in water tanks, etc.

Conductors, Conducts and Insulators:—

Insulating Compound, O. Stiles, Omaha, Neb., 528,744. Filed Mch. 26, 1894.
Consists of a mixture of asbestos, alcohol, shellac and mica.

Distribution:—

Electrical Transformer, R. M. Hunter, Philadelphia, Pa., 528,778. Filed Apl. 6, 1894.

Claim 1 follows:

An electrical converter having its coils hermetically sealed within a lead case, and a powdered moisture-absorbent contained within the lead case.

Galvanic and Thermo-Electric Batteries:—

Galvanic Battery, M. M. Hayden, New York, 528,669. Filed Feb. 21, 1894.

Employs a detachable porous cup provided with a screw threaded plug closing its top and connecting it with the cover of the battery.

Heating:—

Rheostat and Heater, E. C. Mitchell, New York, 528,907. Filed Jan. 17, 1894.
Consists of a metal base, a resistance wire with perforated sheets of non-fusible insulation between it and the base, and a covering of insulating substance.

Lamps and Appurtenances:—

Electric Arc Lamp, C. E. Oagley, New York, 528,684. Filed Feb. 17, 1894.

Claim 9 follows:

The combination with a search light or projector body, of an arc lamp having pivoted carbon carrying arms extending into said body in front of the reflector, and means for moving said arms to maintain the arc.

Measurement:—

Apparatus for Measuring Electricity, W. Friese-Greene, London, Eng., 528,570. Filed March 28, 1894.

Employs a solenoid included in the main circuit, a movable band and clock work mechanism adapted to record as any given moment the number of amperes passing through the meter.

Miscellaneous:—

Apparatus for Electrodeposition, H. L. Bridgman, Blue Island, Ill., 528,586. Filed Oct. 3, 1893.

Apparatus for Electrodeposition, H. L. Bridgman, Blue Island, Ill., 528,587. Filed Oct. 3, 1893.

Plug for Establishing Electrical Connections, C. W. Brown, Montreal, Can., 528,590. Filed Jan. 16, 1894.

A plug provided with flexible expanders holding it firmly in the socket.

Magnet, A. H. Hoyt, Penacook, N. H., 528,635. Filed Mch. 14, 1894.

A permanent magnet composed of a bar of steel with a circular opening substantially surrounded by the magnetic poles.

Feed Water Purifier, H. S. Cabell, Quincy, Ill., 528,851. Filed June 26, 1894.

Railways and Appliances:—

Trolley Wire Clip, J. W. Perry, Philadelphia, Pa., 528,561. Filed May 5, 1894.

Consists of two parts hinged together beneath the wire.

Trolley Catcher, A. S. Osborn, Rochester, N. Y., 528,635. Filed May 9, 1894.

Provides means whereby the trolley pole is automatically drawn downward the instant the trolley accidentally leaves the wire.

Trolley Line Breaker, C. H. Dey & J. M. Anderson, Boston, Mass., 528,767. Filed Feb. 16, 1894.

An insulating joint of such construction as to be capable of being replaced in part while the current is on the line.

Bond for Electric Railways, H. B. Nichols & F. H. Lincoln, Philadelphia, Pa., 528,788. Filed Sept. 20, 1894.

Employs a nut provided with a passage way into which molten metal is poured in order to maintain an absolute contact between the rail and bond.

Switches and Cut-Outs:—

Rheostat, J. C. Fyfe, Chicago, Ill., 528,539. Filed April 27, 1894.

Provides means for ventilating and insulating the conductors by separating the several layers with silicate of soda, which is then crystallized by the application of heat.

Switch Operating Mechanism for Hoisting Machinery, A. J. Shaw, Muskegon, Mich., 528,615. Filed June 7, 1894.

Employs two independent switches with a common operating lever adapted to move either one alone or both together.

Electric Hoisting Machinery, A. J. Shaw, Muskegon, Mich., 528,620. Filed June 25, 1894.

Employs a magnetic brake with a stop to limit its action, and an electromagnet in circuit with the motor to control the position of the stop.

Rheostat, A. J. Shaw, Muskegon, Mich., 528,595. Filed April 10, 1894.

Claim 1 follows:

A resistance device consisting of a band of ribbon of conducting material, crimped or folded facewise, and then coiled edgewise.

Rheostat, A. J. Shaw, Muskegon, Mich., 528,594. Filed April 10, 1894.

Consists of a series of blocks between which are interposed a series of folding conducting strips, and a movable contact arranged to sweep the contact plates.

Electric Switch, F. G. Bolles, Washington, D. C., 528,900. Filed March 27, 1894.

Consists of a device for tightening the contact between the terminals of a switch after the latter is closed.

Telegraph:—

Means for Multiplex Telegraphing Between Cars of Railways, A. Fryer, Bath-on-the-Hudson, N. Y., 528,902. Filed March 17, 1892.

Telephones and Apparatus:—

Combined Municipal Telegraph and Telephone System, H. M. Seitzinger, Wilkesbarre, Pa., 528,566. Filed May 28, 1894.

A system providing for the use of telephones upon circuits which include telegraph or signal instruments.

Telephone Exchange System, W. Childs, Fort Smith, Arkansas, 528,590. Filed May 27, 1890.

An automatic switchboard comprising a series of contact points arranged in concentric circles, and a moving switch contact adapted to cooperate with them.

Telegraphic and Telephonic Exchange System, W. Childs, Fort Smith, Arkansas, 528,591. Filed May 27, 1890.

Similar to No. 528,590.

Telephony, F. R. Colvin, New York, 528,502. Filed July 26, 1894.

Claim 1 follows:—

A system of telephonic intercommunication, comprising a plurality of stations connected in multiple-arc relation to the line, each station being provided with a high potential calling generator and a talking outfit organized to impose on the line low potential talking currents.

Telephony, W. C. Lockwood & J. M. Lockwood, Brooklyn, N. Y., 528,640. Filed June 14, 1894.

Employs a carbon electrode surrounded by broken carbon, and a variable air space between the solid carbon electrode and a plug of wood and carbon secured within the casing of the instrument.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

G. E. SLOW SPEED FOUR-POLE DYNAMOS AND MOTORS.

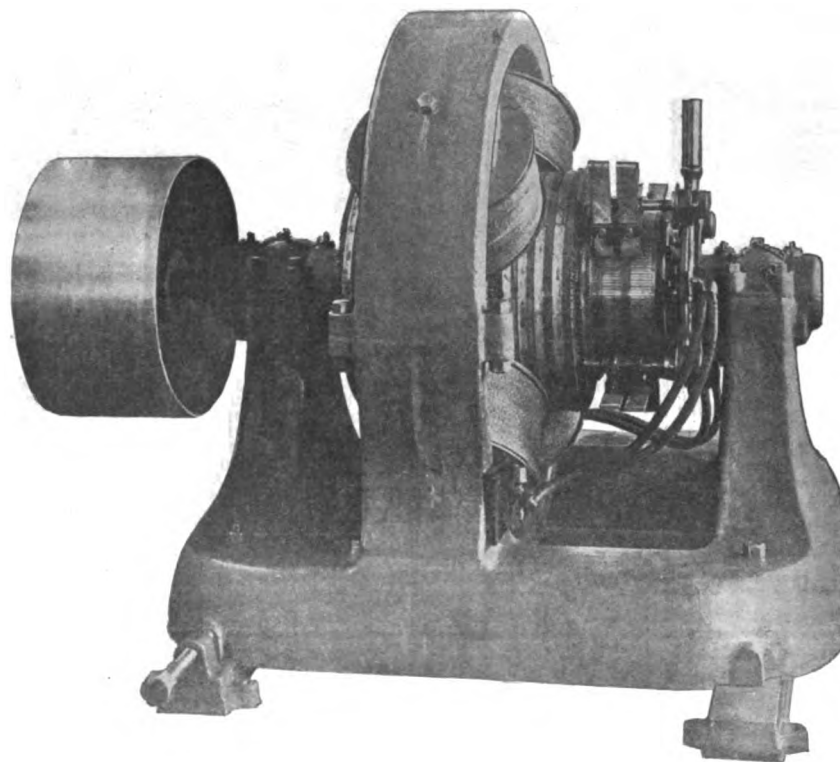
THE General Electric Company has within the past month brought out a new series of slow speed four-pole generators and motors which have given excellent results both under shop test and in commercial operation. The generators which are built in sizes up to 60 KW. have the magnet circuits shortened and a greater output and a higher efficiency are obtained from a given weight and speed than from a bipolar type of generator. The saving of floor space effected by the shape, and slow speed render this type of machine particularly valuable.

The frame and pole pieces are of soft cast steel of the highest magnetic permeability. The armatures are so constructed as to expose the core and windings to constant currents of air; and the copper wire coils are formed and thoroughly insulated before insertion in the core. The insulation is of mica and tough paper

speed motors and generators to run at a slightly higher speed. They differ from the slow speed type only in the fact that the armatures and pulleys and in some cases the field windings are special.

TESTS OF MAGNESIA SECTIONAL COVERING.

ECONOMY in coal consumption can be studied with equal effect outside as well as inside of the engine cylinder, and steam users are beginning to realize that the uncovered or badly covered steam pipe is a heavy drawer on the coal pile. Among the materials designed to prevent this waste of heat and injurious condensation in steam pipes is the Magnesia sectional covering of the Keasbey & Mattison Co. Just how the product of this company compares with that of others designed for the same purpose was recently shown in a test made by Mr. Louis Schmidt, analytical chemist of Cincinnati, for Messrs. S. C. Nightingale & Childs, of Boston, Mass., agents for the Magnesia coverings. In carrying out these tests six 6-foot lengths of 2-inch pipe were covered with six different types of material procured in the open market, and the amount of condensation measured for 8 consecutive hours. The Keasbey & Mattison Magnesia sectional covering showed the lowest condensation, namely, 216 grammes, or 36 grammes per



G. E. SLOW SPEED FOUR-POLE DYNAMO AND MOTOR.

and possesses the highest spark resisting qualities as well as great mechanical strength and durability. The design is such that at full load and continuous run the temperature is only slightly elevated. The commutator and brushes work perfectly under all conditions of load and the brush holders have a parallel motion which ensures perfect contact with the commutator at all times. The pillow blocks are cast in one piece with the bed plate and thus it is impossible for the self-aligning and self oiling bearings to get out of line and the armature off centre. The armature spider is extended and the windings are bound down solid upon it. This gives additional radiating surface and overcomes the difficulty entailed by loose binding wires, while the shape of the spider and the coil allows the ready replacement of an injured coil when necessary. The commutator is pressed upon the shaft and then keyed and the winding sections and commutator bars are directly connected. The brush holders are all mounted on a rocker arm and may be shifted simultaneously upon the commutator face. They are so constructed that the brushes will always be presented to the commutator surface at the same angle.

The slow speed motors are similar in appearance to the generators and by changing the field spools the motor can be changed to a generator for lighting or power purposes and vice versa. All parts are interchangeable; the motors are absolutely sparkless and changes in load from overload to no load may be made without varying the position of the brushes.

In addition to the above mentioned generators and motors, the General Electric Company has designed a line of moderate

foot per hour. The next best covering showed 238 grammes and the lowest on the list, 392 grammes for 8 hours.

The various anti-condensation coverings were also tested for resistance to crushing, both before and after subjecting them to the heat of the steam pipe. The result showed that the Magnesia covering retained its strength absolutely and that while before heating, the nearest competitor had only about $\frac{1}{3}$ the strength of the Magnesia, after heating all except the Magnesia had greatly deteriorated the next in order having less than one-sixth the strength of Magnesia. Tests were also made by soaking the various materials in water for three weeks. The Magnesia remained rigid while the others softened and disintegrated.

The report of Mr. Schmidt, which is in the shape of an affidavit, also gives the result of a chemical analysis of the various coverings, which shows that all the other materials tested contained from 81 to 90 per cent. of sulphate of lime, while the Magnesia covering contained none of this material. The analysis of Magnesia showed the following composition: Magnesia, 89.59 %; sulphate of lime, none; alumina and iron, 2.65 %; asbestos, 4.78 %; moisture, 2.98 %.

The results given above confirms the excellent qualities of Magnesia covering, which has already gained such popularity among steam users.

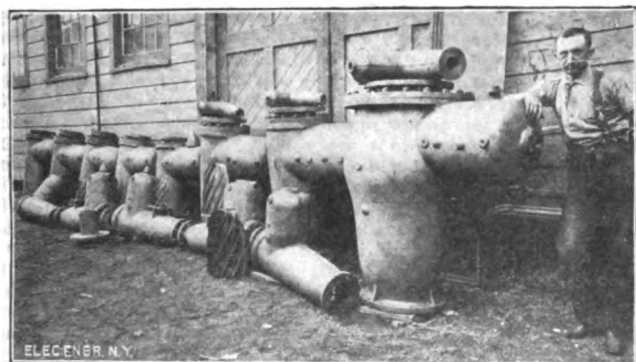
THE NASSAU ELECTRIC RAILROAD CO. of Brooklyn, are having trouble from the fact that some of their agents turned in forged "consents," and the city is now trying to stop it, on that ground, for laying portions of its road.

THE DE RYCKE STEAM SEPARATORS.

The necessity and importance of dry steam is well recognized by those who have charge of central stations, isolated plants, and power houses; but in many instances the space is grudging for such a useful piece of apparatus as a steam separator. Dry steam is a great desideratum, however, and hence there often arises a difficulty due to the demands of the engine and the lack of the space required by the usual common form of separator. The problem here suggested has been carefully studied by Mr. Joseph de Rycke of 145 Broadway, and his separators have won for themselves a large measure of popularity in electrical circles, not only for their high efficiency but for their really marvelous compactness. We are glad to be able to illustrate herewith, from a photograph just taken, a row of the de Rycke separators previous to shipment. Those shown here range in size from 18 inches down to 1½ inch, the largest being that at the extreme right, while the smallest may be noted on top of the others in the middle. They are all strikingly compact and economical of space. The height of the 18 inch is only 5 feet 3 inches, while the greatest diameter is but 36 inches.

The Franklin Institute of Philadelphia after an investigation of the subject, including a study of some 36 U. S. and 26 British patents in this field, has, Mr. de Rycke informs us, awarded him a certificate of merit. What is perhaps even more to the purpose is the following list of practical testimonials in the shape of orders from all parts of the country, for Mr. de Rycke's separators:—

Brush Electric Co. of Baltimore, three 10", thirteen 8" and two 5"; Baltimore Traction, four 8"; Baltimore Street R. R. four 10"; Baltimore Electric Smelting Co. one 10"; Koster & Bial's Music Hall, one 8" and one 6 inch; Tug "Sanford," one 7"; Armory Mills, one 8"; Beaver Valley Traction Co., Beaver Falls, Pa., one 8"; Bath Gas & Electric Co., one 5"; Athol, Mass., Gas & Electric



DE RYCKE STEAM SEPARATORS.

Co., one 4' and one 6'; Dayton, Ohio, Street R. R. Co., three 10"; Catholic Club, one 5'; Reunert & Lenz, Johannesburg, South Africa, two 2', two 4' and two 6'; Maracaibo, Venezuela, Electric Light Co., one 16' and two 7'; St. John's, Mich., Electric Light Co., one 6'; Wayne Co. House, Mich., one 3'; Risdon Iron Works, San Francisco, two 3½", two 6", two 7' and two 8"; F. M. Merrill, Milwaukee, Wis., two 2½"; Edward P. Allis Engine Co., Milwaukee, Wis., two 12"; West End Street R. R. Boston, three 6"; Lonsdale Mills, Providence, one 12", one 10' and one 6"; Crane Company, one 6", one 5' and one 4½"; Department Public Works, St. John's, N. B., one 6"; Brookline, Mass., Water Works, one 5"; The Corliss Steam Engine Co., of Providence, three 6"; A. Leimen, Moscow, Russia, two 3'.

COMBINATION FIXTURE BIDS FOR PUBLIC BUILDINGS.

Bids were opened at the Treasury Department on Nov. 10, 1894, for manufacturing and placing in position in complete working order combination gas and electric light fixtures in the following named public buildings:

1, Houlton, Me. 2, Lewiston, Me. 3, Staunton, Va. 4, Fremont, Neb.

The following were the bids submitted:

Horn & Brannon Manufacturing Co., Philadelphia, (1), \$375; (2), \$296.25; (3), \$462; (4), \$90.50.
Brooklyn Brass Fixture Co., Brooklyn, N. Y., (1), \$488.20; (2), \$314.77; (3), \$697.91; (4), \$392.38.
Western Gas Fixture Co., Toledo, O., (1), \$411.88; (2), \$341.84; (3), \$553.08; (4), \$346.08.
W. C. Vosburgh Manufacturing Co., Brooklyn, N. Y., (2), \$399.50; (3), \$878.50; (4), \$510.
Nichols Gas Fixture Manufacturing Co., Brooklyn, N. Y., (1), \$480.25; (2), \$397.10; (3), \$733.45; (4), \$343.50.

Schultz Gas Fixture Co., Baltimore, Md., (1), \$461.25; (2), \$359.15; (3), \$551.40; (4), \$314.50.

R. Hollings & Co., Boston, Mass., (1), \$553; (2), \$404; (3), \$331.50; (4), \$505.25.

A. H. Revell, Chicago, Ill., (1), \$494; (2), \$418; (3), \$348; (4), \$394.

Mitchell Vance Co., New York, N. Y., (1), \$502.80; (2), \$365.10; (3), \$658.90; (4), \$365.45.

F. M. Russell & Co., Omaha, Neb., (4), \$459.

Morrison Southern Electric Co., Baltimore, Md., (1), \$313; (2), \$251.75; (3), \$477.50; (4), \$205.50.

BIDS FOR A PACIFIC CABLE.

Bids for the construction and maintenance of a Pacific cable have been opened by the Canadian minister of trade. The definite proposals were six in number as follows. 1, Francis A. Bowen; 2, The Telegraph Construction and Maintenance Company; 3, Messrs. Siemens Bros.; 4, the Fowler-Waring Cable Company; 5, W. T. Henley's Telegraph Works Company; 6, the India Rubber, Gutta Percha and Telegraph Company, all of London. These are the chief cable manufacturing and construction companies of the world, and their proposals indicate a thorough examination of the great project. The offers apply to each of the eight routes proposed, and in every case are below the estimates made by Mr. Sanford Fleming already made public. One very noticeable feature of the tenders is that none of them makes any difference in the routes by way of Necker Island as compared with that by way of Fanning Island, so that the consent of the Hawaiian and United States governments to the use for landing purposes, if thought advisable, is not of so much importance as at one time it was thought it might be.

THE CHLORIDE ACCUMULATOR LITIGATION.

We have received the following from the Electric Storage Battery Co., of Philadelphia:—

In reference to the decision of the United States Court of Appeals for 2nd District, in case of Accumulator Company versus Edison Electric Illuminating Company:

The day following the opinion of the Court upon the application of the Counsel for the Edison Company, the Court gave leave to file an application for rehearing to be submitted in printed form, and accompanied with a printed argument in support thereof, and denied the motion of the Counsel for The Accumulator Company for the mandate, holding that in abeyance until the decision was given upon the petition for a rehearing.

The decision in no way affects the business of The Electric Storage Battery Company, but applies solely to The New York Edison contract, and even if affirmed will only delay that work until May next when the Swan patent expires.

Very truly yours,

THE ELECTRIC STORAGE BATTERY COMPANY,
W. W. GIBBS, President.

PHILADELPHIA, Nov. 17, 1894.

ELECTRIC RAILWAY MATERIAL WANTED.

Mr. Frank E. Holliday, of Ironton, O., where he may be addressed, writes us that he is at the head of the proposed electric street railway between Pomeroy and Middleport, O., a distance of five miles. He is in the market for second hand material, and will probably require some first hand also.

PHILADELPHIA NOTES.

HARRY S. SMITH & CO., LTD., 607 Chestnut street, have recently closed a contract for an electric lighting plant for a large lumber mill of the North Carolina Lumber Co., Tillery, N. C., consisting of one 15 kw. Crocker-Wheeler dynamo and 200 incandescent lights together with a number of incandescent arc lights. This company have also just completed the installation of one 45 kw. Mather ring type dynamo together with switchboard and apparatus for furnishing current for lights and over 100 irons furnished by the Central Electric Heating Co. for the handkerchief factory of Herrmann Aukam & Co., Lebanon, Pa.

THE COMMONWEALTH ELECTRIC CONSTRUCTION CO., of 418 Market street, has under its present management increased its capital stock to \$100,000 and appointed the following officers: Louis B. Henry, president; W. W. Hartel, treasurer; Jas. W. Garrett, secretary; Philip A. Meehan, superintendent. As soon as additional quarters can be procured they will materially increase their plant and manufacture direct and alternating machinery from 2 H. P. up, and make electric railway work a specialty. The construction and repair departments will be continued under the management of Mr. F. A. Chapman.

NEW ENGLAND NOTES.

THE WESTINGHOUSE ELEC. & MFG. CO. has removed its New England office from 630 Atlantic Ave. to the Exchange Building 58 State street, Boston.

THE NEW ENGLAND ELECTROLYTIC COPPER CO. at Central Falls, R. I., have just completed an addition to their works, which addition is made entirely of iron and steel, furnished by the Berlin Iron Bridge Co.

WESTINGHOUSE, CHURCH, KERR & Co. have removed their Boston office from 620 Atlantic Avenue to Exchange building, 58 State Street.

BRIDGEPORT, CONN.—The trolley cars of the Bridgeport Traction Co. are to be warmed by the heaters of the Central Electric Heating Co. under supervision of Col. Heft, manager of the road.

MR. F. E. PETTINGELL's resignation has been accepted by the Thomson-Brown Electric Co., of Boston, and he has now no further connection with that company.

THE WEST END RAILWAY of Boston has ordered 149 cars equipped with the electric heater made by the Consolidated Car Heating Co. of Albany, after a severe test of various apparatus of this nature.

MR. ALTON D. ADAMS, electrical engineer, 620 Atlantic avenue, Boston, is now making a specialty of heavy central station repairs, and has facilities for this work second to none in the country. The shop is all on the first floor and machines are unloaded from cars by cranes directly into it. Mr. Adams' long experience in the manufacture of electrical machinery indicates that work placed in his hands will be well cared for.

MR. R. O. HOOD, who has been for some time in charge of the meter business of the General Electric Co., for New England, has resigned from that Company and opened an office at 15 Federal St., where he will attend to the sales of Wagner transformers and Columbia lamps in New England. Mr. Hood is well known as an expert on electrical meters. He is thoroughly acquainted with the N. E. trade which, combined with the high character of the goods he will handle, we feel will insure his success.

THE BOSTON ELECTRIC LIGHT CO. are busy getting their underground conduits ready for occupancy, and have recently ordered about 86 miles of wire of various manufacture for immediate delivery and use. Among the different cables which they will use at present will be Washburn & Moen, Safety, Habirshaw, Kerite and Clark. Next year a very much larger amount of underground work will be done, and they will continue in this work for the next five years till all the city circuits are buried.

THE NATIONAL SCHOOL OF ELECTRICITY has opened a New England Agency in the Carter Building, Boston, and will be represented here by Mr. H. W. Pope of New York. A public meeting will be held on Tuesday evening, Nov. 20th, at 8 o'clock, in Wesleyan Hall, No. 86 Bromfield Street, for the purpose of explaining in detail the plans and purposes of the National School of Electricity under whose auspices classes are being formed in all the principal cities and towns of the country for the study of the science of electricity.

THE PERKINS ELECTRIC MANUFACTURING CO. of Hartford, Conn., are about ready to move into their handsome new factory in Hartford. They have recently erected a substantial three story building, which they have equipped with the most recent machinery, and will now be in a better position than ever to turn out their regular line of switches, sockets, Waterhouse arc lamps, etc. They have also secured ample ground in the vicinity for the erection of other buildings for future increase, which they will undoubtedly soon require, should they commence the manufacture of incandescent lamps.

CRAIGHEAD & KINTZ Co., represented by R. M. Kittson, 370 Washington street, Boston, are getting some very good reports of their new arc lamp. Mr. T. Cooper, of the Pekin, Ill., Electric Light Co., says: "It gives better satisfaction than any lamp we have ever used," and the Greensboro, N. C., Electric Light Co., R. J. Marks, manager, remark: "The only reason why any company burn double carbon arc lamps at two or three times the cost of 'C. & K.' is because they have never used the 'C. & K.'; and they are just in the same position as we were before we tried them." Such testimonials are worth having.

THE CAMPBELL ELECTRICAL SUPPLY CO., of Boston, are placing on the market a new form of protected insulated wire which should prove interesting to electrical engineers. This wire in addition to the usual insulation, either for line wire, or for high rubber insulation, is protected by means of a fine galvanized steel wire, which is braided on it, below the outside covering. It adds greatly to its abrasion resisting qualities, and being braided on, cannot in any way damage the insulation by cutting into it. They are also introducing a thoroughly fireproof magnet wire, which it is absolutely impossible for any ordinary amount of heat to carbonize, and which should prove extremely interesting to builders of dynamo machinery.

THE JEWELL BELTING CO., of Hartford, Conn., recently found a great deal of encouragement in increasing business, and are at present quite busy on many orders for belts for electric light and railway purposes, in addition to their large business in other fields. Among their recent orders may be mentioned a few of the more important:—Danbury & Bethel Horse Railroad, Danbury, Ct., six 27 inch belts of the railway dynamo type, for their new power house; Hartford & West Hartford Horse Railroad Co., Hartford, Ct., one 24 inch double, one 48 inch double and one 60 inch three ply, besides a number of other smaller belts; Jamestown Electric Light and Power Co., Jamestown, N. Y., 85 inch double and a number of smaller engine and dynamo belts.

THE DAVIDSON VENTILATING FAN CO., of Boston, New England agents for the Wenstrom dynamos, have secured the contract for the electric lighting of the Rumford Falls Paper Co., Rumford Falls, Me., and will commence work at once. They have also just taken the agency for a very clever device invented by Mr. Henry Hall, of Boston. The device is intended for the simultaneous turning of all the signboards on the tops of electric cars. At present it is the habit of the conductor near or at the end of the route to go out with a long stick and turn round the four sign boards. Mr. Hall's device consists in mounting all the revolving boards on spindles, geared to one another with beveled gears, and connected with a vertical spindle with hand wheel and index convenient to the use of the conductor. By turning the hand wheel all the boards are operated at once, and the conductor can tell at a glance just what is visible to pedestrians. Current can also be led into these revolving boards for the purpose of illuminating them by means of incandescent lamps in their interior.

THE EDISON ELECTRIC ILLUMINATING CO., OF BOSTON, have just closed a contract with the Accumulatoren Fabrik Aktiengesellschaft, of Hagen, Westphalia, Germany, for a second storage battery, similar to the one they have now in use, but of twice the size. The battery will comprise 140 cells, each cell being 2 volts and having a capacity of 8,800 amperes for a maximum discharge and 1,716 amperes for an average discharge. When using the maximum current the battery will discharge in 1½ hours, and when using the average current, it will take three hours to discharge the battery. In other words the battery will be able to furnish current for about 15,000 lights for one hour and a half. The cells are each about 45 inches square and 8 feet high, and they will be installed in the 1st district station at Head Place. The Company are now erecting a four story building, specially designed for this battery, which will weigh when filled with liquid over 300 tons. These two batteries, the one at the Atlantic avenue station and the one just ordered, will make the largest equipment of this kind in the world, the one coming nearest to it, probably being the installation at Hamburg, Germany. The battery in the Atlantic avenue station has now been in constant use for about 8 months, with perfect success, and it has been found to be a most valuable auxiliary in many different ways, as indeed is proved by this second order.

PACKARD LAMPS AND TRANSFORMERS.

A recent visit to the Packard factories at Warren, Ohio, finds them running full handed in all departments. The Messrs. Packard state that their new transformer is meeting with unqualified success and are especially proud of its "lightning" record, not one of them having ever been burned out or disabled from this cause, although often used on the same lines where other makes of transformers succumbed. They report that they are receiving many inquiries from incandescent lamp users, who say that they have had enough of experimenting with "new" lamps, for the genuine old style Packard lamp. These lamps they are now ready to supply promptly in any quantity. The Messrs. Packard state that recent improvements in the lamp factory make it second to none in the world and will enable them to fully maintain and improve the quality of their lamps in spite of the recent great reductions in prices.

BATTERY SUPPLIES FOR THE GOVERNMENT.

Kennedy & DuPerow, of Washington, D. C., have been awarded the contract for furnishing the following electric battery supplies for the use of the Public Buildings and Grounds: Gravity coppers, 5x7 and 6x8 inch, 6 cents each; crowfoot zincs, 6x8 inch, 28 cents each; office wire, No. 16, Phillips's patent braided, 21 cents per pound; battery jars, 6-inch, 16 cents each; Leclanché battery zincs, 4 cents each.

Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE Electrical Engineer.

Vol. XVIII.

NOVEMBER 28, 1894.

No. 343.

THE "WOOD" ARC LIGHT TRANSFORMER.



PERATING arc lights on alternating currents has been accomplished with more or less success for some years, but, owing to several drawbacks, the method has not so far attained the sweeping success which its advocates hoped for. In the first attempts in this direction an arc lamp was run from a 50 volt transformer with sufficient resistance in series to prevent short-circuiting of the transformer, when the lamp carbons were in contact. Then three lamps were run in series from a 100-volt transformer with somewhat less resistance, and, recently, special 30 volt transformers have been used without any resistance. Others have tried choke coils or reactive coils in series with the lamps, but in all of the above arrangements it was found necessary to use a high grade of cored carbon in order to obtain a steady and uniform light. This, as well as other disadvantages, made the operation of the lamps generally too expensive to compete with the direct



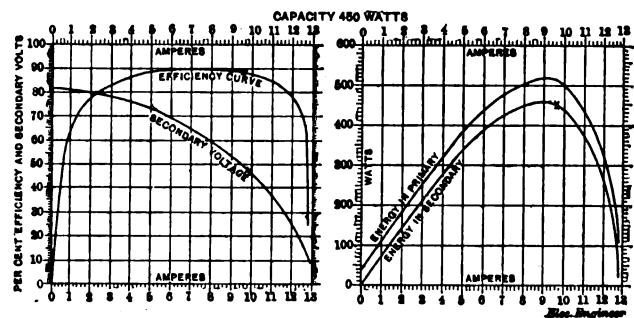
FIG. 3.—THE "WOOD" ARC LIGHT TRANSFORMER.

current series system. Mr. James J. Wood of the Ft. Wayne Electric Corporation some time ago attacked the problem with a view of eliminating, if possible, all the drawbacks of existing methods, and the result is embodied in a new transformer.

The Wood arc light transformer, by a proper proportioning between the primary and secondary coils and the iron core, will maintain an absolutely constant current of 9.6 amperes in its secondary, with a pressure of 48 to 50 volts. If the resistance of the secondary circuit is decreased, the secondary voltage rapidly falls, reaching zero when the terminals are short-circuited. Figs. 1 and 2 show the efficiency, secondary E. M. F. and relative energy in the primary and secondary coils of such a transformer, giving an efficiency of over 87 per cent. at the lamp.

The advantages of such a transformer will be readily recognized by the electrical engineer. Not only are resistance or choke coils rendered unnecessary, but the use of

expensive cored carbons is done away with, for at 48 or 50 volts and with 9.6 amperes, ordinary arc light carbons can be used, giving a full 2000 C. P. light, absolutely steady



FIGS. 1 AND 2.—CURVES SHOWING ACTION OF WOOD ARC LIGHT TRANSFORMER.

and uniform. Fig. 3 shows a transformer complete placed in a neatly designed case.

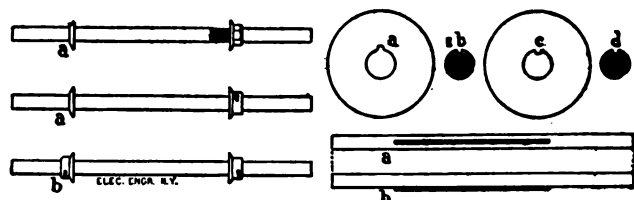
ELECTRICAL MACHINIST PRACTICE.—XI.

BY

James F. Hobart,

Several methods of putting discs upon armature shafts are in use by different dynamo and motor builders. The time honored screw and nut have been used for years, and are still doing good work in a number of representative types. The more advanced makers have discarded this method, shown in Fig. 40, and employ the cheaper form of construction, shown in Fig. 41. This is the collar and pin fastening which has been found to cost much less than the screw. It seems as if a further departure would be in order, so that both ends of the shaft could be made alike, as in Fig. 42, both collars being pinned on, instead of one being tight, and forged or shrunk on the shaft as at *a, a*, Figs. 40 and 41. This collar should be welded on to make sure of a good job, and such a weld is better than the pin *b*, Fig. 42.

Before generators and motors had been manufactured



FIGS. 40 TO 45.

long, it was found very desirable to fasten the armature core so that there would be no danger of its turning or creeping around on the shaft. The magnetic torque is so heavy and is so liable to be exerted at its maximum in an instant of time that some fastening became an absolute

necessity to prevent movement of the armature around the shaft, to the detriment of the commutator connections and of the efficiency of the machinery as well. The readiest means of preventing such movement was to notch the sheet iron segments as shown at *a*, Fig. 43, spline the armature shaft, as shown at *b*, and put in a feather that

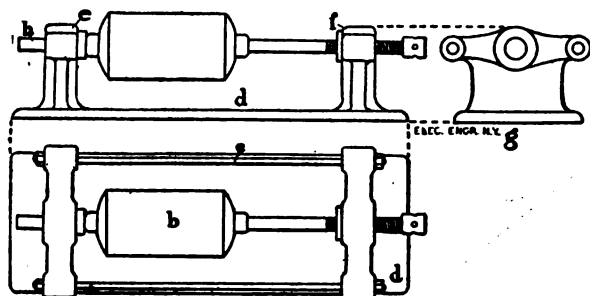
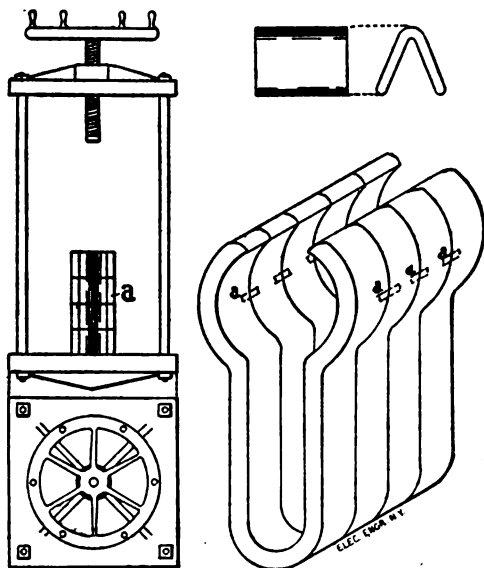


FIG. 46.

will just fit between the collars when the loose one is screwed home, as shown at *a* and *b*, Fig. 44.

Progress has kept up with the procession in this matter, as well as in the pin method noted above. Instead of the costly slotted shaft and nicely fitted feather, each disc has a projection *c*, Fig. 45, left in the shaft space, which fits snugly into the groove in the shaft shown at *d*. This is very effectual. The armature cannot move sidewise in the least as the soft iron armature discs are very strong and stiff edge wise, in the direction of the torque strain. The slot need only be made when the discs are to stand, as the little sheet metal lugs are easily turned up to allow the disc to go over the ends of the shaft where no slot can be allowed. Once over, the lug is straightened out again, and goes into its place without trouble.

The paper insulation between discs may be cut plain, without the projecting lug, but if the maker prefers, the paper may be pressed out with the same die (or one just like it) that cuts out the iron discs. Then, of course, the insulation between the discs will be more perfect than if the projecting parts of the discs were left to come in contact with each other, as they are pretty sure to do



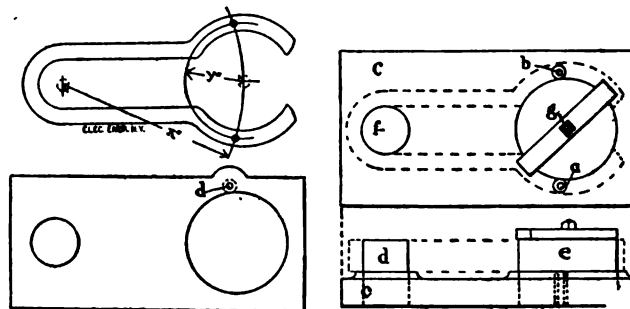
FIGS. 47, 48 AND 49.

without the little pieces of paper between them. However, slight contacts at that point (along the shaft) are not particularly objectionable, as may be seen from the fact that the wooden or vulcanite core, once so indispensable between shaft and core, is not used by many makers. The discs being fitted directly and closely upon the shaft, there

is a good contact between them. If such contact proves magnetically objectionable, a thin brass sleeve, fitting into the groove, may be fitted to the armature shaft and the discs put into position upon this sleeve.

After dispensing with the nut and screw upon each armature, some way of squeezing the discs of iron and paper into place must be found. If only a few armatures are to be made, this may be done in an ordinary drill press, or in a planer. Small armatures can be screwed upon the lathe, but that tool was not built for such usage, and the less of such work done in it, the better for the lathe. One motor builder, who uses the collar and pin, instead of the screw and nut, has designed a special press for the work. Fig. 46 gives an outline diagram of it, in side elevation and in plan view.

The press consists principally of the two stout castings *e* and *f*. They are cast on a very light base plate, which of itself is not nearly sufficient to stand the strain of the screw, but, reinforced by the rods *c* and *d* the screw will strip before the rest of the press gives way. The end view *g*, which represents only the casting, with screw and rods removed, shows that the hole in the casting is much larger than is required for the screw. This is for two reasons; to allow the nut to be



FIGS. 50, 51 AND 52.

made separate and slipped into place, and to allow one end of the armature shaft to go through one of the castings so that the bearing on the press will come against the loose collar on the armature shaft. By putting the shaft into the press in this manner, there is a chance for the shaft to be turned around if necessary to bring the pin holes fair. A clamp, dog, or pair of pipe tongs applied to the end of the shaft which projects at *h*, allows a fine opportunity for adjusting that part. This proposed press is in process of construction, and is expected to greatly facilitate the operation of putting together armatures. But, without having used it, it seems as though a vertical one would be much handier. Certainly it would be very handy in any shop, and would do duty as an arbor press when not putting up armatures.

Fig. 47 gives an idea of such a press, which ought not to cost more than that shown in Fig. 46, and which possesses much greater value as a general shop tool. It consists mainly of two castiron plates, about 20 inches square for top and bottom, with 2-inch iron rods fitted to the castings as shown, and a hand wheel and screw tapped through the top plate. The numerous handles projecting from the top of the hand-wheel, allow a man to get hold of it almost anywhere. The casting *a*, shown more plainly in Fig. 48, is handy both for pressing armatures, and for general work. In Fig. 47, four of these castings are shown, placed one upon the other to secure the required height. All that need be done to these castings, is to face up the ends after they come from the foundry, but frequently this is not done, and the rough ends do not fit as well as they should, and give trouble when nice work is required.

The spacing of holes, and the building of jigs to allow such holes to be drilled quickly and accurately, is an important part of the electrical machinist's work. A case came up recently where it was necessary to dowel together several

small permanent magnets so as to form one compound magneto-field. Fig. 49 shows the compound arrangement, and the dotted lines a, a, a, a , show the position of the dowel pins. The holes had to be accurately located, as shown by Fig. 50, in order that the magnets could be assembled either side up as it happened. A very simple jig for drilling the dowel holes, is shown in Fig. 51. The position of the magnet is shown by the dotted lines, and a and b are the steel bushed holes for drilling through, the drill being inserted from the lower, or back side of the jig. To lay out the holes in this jig, a very simple method was followed. When the base c was bored to receive the pins d and e on which the magnets are held, a plain piece of thin iron was clamped to it and drilled with it. This plate is shown in Fig. 52. The hole d is located by careful measurement with a pair of dividers, from the centres of pins f and g , Fig. 51. After one hole is drilled at a , the templet, Fig. 52, is turned bottom side up and replaced on pins d and e , Fig. 51; this brings the templet into position for drilling the hole b , and by the method used, holes a and b cannot fail to come at equal distances from the centres f and g .

The drilling jig is bushed with hardened steel quills b and d , Fig. 51, these bushings were turned up a little larger than the holes in which they are placed. After hardening, they were found to be a good drive fit. The allowance for shrinkage must be very slight—not over .001" for a one-fourth inch bushing. It is better, however, to allow too much rather than too little, for the excess is readily removed by putting the bushing in a lathe and treating it with a little emery paper, or emery and oil.

In case the hole comes out too small after hardening, it can be easily enlarged by a little emery and oil on a bit of pine wood that will just go into the hole. Put one end of the wood in a chuck, or drive it into the hole in the line spindle of the speed lathe; turn it down to fit the hole in the bushing, and then charge the stick with emery and oil and grind the hole up to size. Be sure to get out all the emery, or some of it remaining in the hole, embedded in the steel, may spoil the drill used with the bushing.

THE EARLY MORNING TEST IN TELEPHONE OFFICES.

BY

Jas. W. Manson

In every telephone office a test of all wires entering the exchange is made in the morning by the day operators, a piece of work, which, when carefully done, well repays the trouble taken, but which should not be, as is often the case, the only regular means of obtaining information about the electrical condition of subscribers' lines. Without underestimating the value of a morning test by the operators, and, in fact, regarding it as indispensable, it may yet be said that the circumstances under which it is made are not the most favorable that could be desired.

The work is, of necessity, divided among the whole force on duty, with the result that every operator applies to the circuits in her allotted portion her own standard of what constitutes a properly working line, and does it, too, under very trying conditions. Again, the work is not, strictly speaking, "operating," and, while it lasts, it delays regular business to some extent; two considerations which make it looked upon by some as a perfunctory task to be got rid of as soon as possible.

Leaving aside these shortcomings, however, the serious objection remains that the test is not finished before the greater part of the subscribers are in their offices—a comparatively late hour in the morning,—and, as a conse-

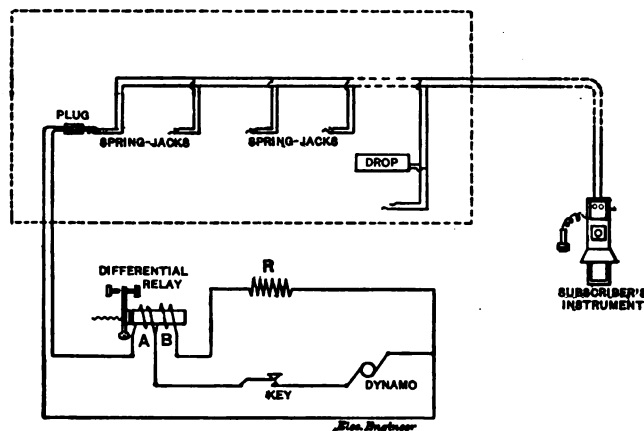
quence, a large proportion of the lines found in trouble by this means is not repaired till late in the forenoon, at a time when the need for telephones has much diminished.

This is a bad start for a day's work, and the office manager has the unpleasant knowledge that his linemen have lost an hour or more, waiting for orders to go on troubles that developed over night, but of whose existence he was ignorant.

In the company with which the writer is connected, it is the practice to have all lines tested by the night manager for "ground" and "open," by means of a relay and battery. It is possible, in this way, for one man to quickly try every working wire in the early morning, and prepare a list of troubles to be acted on as soon as the day force arrives. Experience has abundantly shown the value of this system.

With the older styles of switchboard, in which the insertion of a plug cuts out the drop, it is an easy matter to test all wires from one of the sections of the board itself; but, with the bridging type of board, the case is more difficult as the drop is never cut out, and a line will show closed through the drop irrespective of its condition outside the office.

To overcome this obstacle, the writer devised the differential method of testing indicated in the accompanying diagram. In the latter, the part within the dotted lines represents the course of a circuit through the switchboard,



DIFFERENTIAL METHOD OF TESTING TELEPHONE LINES.

with normally open springjacks and high resistance drop. On the right is the line leading to the subscriber's station; the lower part of the figure shows the testing outfit, its essential features being a differentially wound relay or galvanometer; a resistance R , equal to that of a regular switchboard drop; a dynamo or battery; and a plug with flexible cord to connect with any circuit desired.

To make the test, the plug is inserted in a springjack, as shown, and the key closed. In case the line is open at any point outside the office, the current from the dynamo divides equally between the two coils, A and B , of the differential relay, with consequently no effect on its armature. If, on the contrary, the line is intact, coil A gets more current than coil B , as the joint resistance of subscriber's line and drop in parallel is less than that of R . When a line is closed, then the relay armature is attracted with an intensity proportional to the difference between the currents flowing through the coils A and B .

With a long line and high resistance instruments at subscriber's station—the most unfavorable conditions for the test—this difference, is, of course, small, and the writer would recommend the use of a rather sensitive relay or galvanometer to obtain the best results.

As to the advantages of early morning testing, it is unnecessary to say more, for, though often unappreciated, they cannot well be disputed, nor can the statement that an office failing in this respect loses a valuable auxiliary in the detection of trouble.

THE KEARNEY, NEB. WATER POWER.

In *THE ELECTRICAL ENGINEER* of December, 1888, appeared a very interesting article from the pen of Prof. D. C. Jackson (then engaged in active electrical engineering work) on the water power and electric distribution plant at Kearney, one of the new and most promising



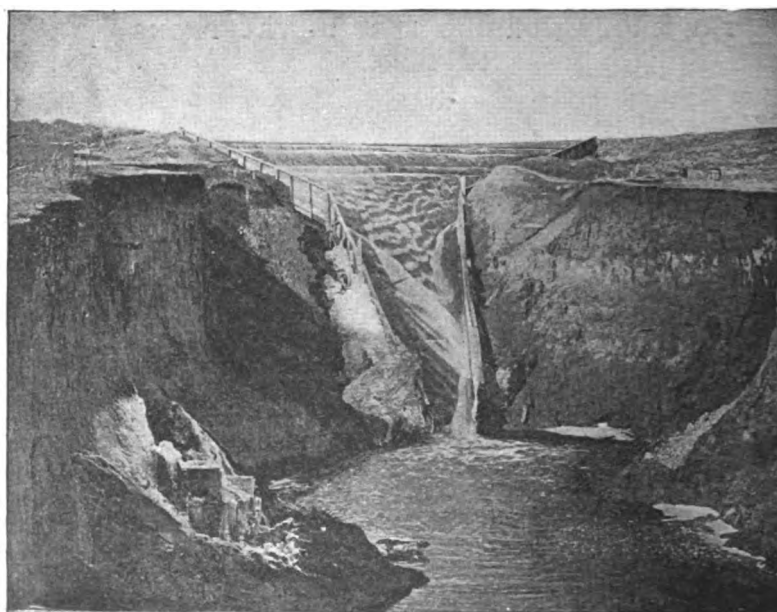
THE KEARNEY, NEB., ELECTRIC LIGHT AND POWER STATION.

cities of Nebraska. Such schemes were novelties in those days, and the plan adopted at Kearney had many features peculiar to itself. In order to utilize the slight fall of the sandy Platte River, a canal 20 feet wide and about 4 feet deep was opened about 17 miles above the city whither it came by a winding route. This canal is fed also by a "rising basin," which draws an inexhaustible supply from the subterranean waters of the Platte, said to be greater in volume than those that flow at the surface. At Kearney, the river had dropped 119 feet and the canal only 24, leaving a fall of 95 feet between the waste weir and the river. Of this, 15 feet was lost in the tail race, leaving a fall of 80 feet utilizable on the water-wheels. When Prof. Jackson wrote his article there was an average depth of 9 inches on the water weir, which was 100 feet long, and about 2,000 H. P. was available. A portion of this power was employed to operate an electric lighting and transmission station. Dynamos capable of producing 275 volts each, were run two in series, giving a total possible pressure between the positive and negative wires of 550 volts at the dynamo. Twenty per cent. being lost in the line, at full load, this would give 440 volts at the lamps and motors between the positive and negative wires, and 220 volts between the neutral wire and either positive or negative wire. Incandescent lamps of 110 volts were run two in series. Motors below 5 H. P. were grouped to run at 220 volts, and those above 5 H. P. ran across the positive and negative, getting the full 440 volts.

It is interesting and timely to note that the scheme has not been allowed to fall into desuetude, but that the growth of the beautiful city and the energy of its people, have led on to the adoption of greater plans, towards the success of which the return of general prosperity will im-

mediately contribute. We illustrate the power house as it stands to-day, exterior and interior. It has 7 dynamos, one pair of 350 H. P. turbine wheels and one pair 800 H. P. turbines, as well as one 425 H. P. supplemental engine. Nearly every industry in the city to-day uses electric power from this plant, including a flour mill with a capacity of 200 barrels per day, which shut down its steam engine of 125 H. P. nearly a year ago. There are in use 3,000 Edison incandescent lights, 50 Thomson-Houston arcs, 250 H. P. of stationary motors, 68 miles of wire and $5\frac{1}{2}$ miles of electric road. These electrical interests have of late been consolidated, and the gas company has also been gathered in, constituting a property of great present and prospective value.

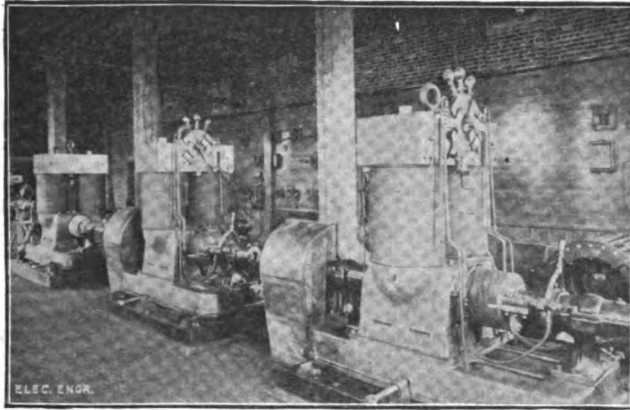
We illustrate also the overflow of the Kearney Canal, as it is the central point in the plans now adopted for increasing the electrical power distribution. Appreciating the importance of the water power, and what it had already done for the city, as well as for the general development of central Nebraska, the municipal authorities of Kearney have donated to the canal this year the sum of \$60,000, additional to \$30,000 given before, with the object of enlarging the canal from its present capacity of 2,000 H. P. to 9,000 or 10,000 H. P. This important enlargement is now being made. When the money has been expended, the size of the canal will have been increased from 25 feet width, and $4\frac{1}{2}$ feet depth, to 40 feet width and 9 feet depth, while the length will be 20 miles. The direct fall at the power house will be 60 feet. All the woodwork on the water weir, shown in the cut, has been removed, and is now being replaced by solid masonry. The breadth of the overflow has been widened from 100 feet to 150 feet,



OVERFLOW OF THE KEARNEY, NEB., WATER POWER CANAL.

allowing a stream $3\frac{1}{2}$ feet deep to flow over a granite dam. The water will fall on a water cushion surrounded by a concrete enclosure. When the work is completed, this power is to be used in the generation of current not only for the present consumers but for those who may be scattered around Kearney for miles and who need cheap power for a variety of industries. This water power is owned by the Geo. W. Frank Improvement Co., of Kearney,

whose principals have been among the most active, energetic, and intelligent promoters in this way, not only of their own fortunes, but of the prosperity of the city as a whole. Even should it be necessary, as a result of the



DYNAMO ROOM, KEARNEY CENTRAL STATION.

growth of the place, to resort in time to the partial use of steam it is obvious that in its control of cheap natural power utilized electrically, Kearney has great advantages that must redound to her benefit as the years go by.

MR. EDISON ON THE WORK OF CENTRAL STATIONS.

Mr. Edison was recently interviewed for our English contemporary *Lightning* by Mr. Fred. Bathurst, who succeeded very intelligently in eliciting a number of shrewd comments on the electrical situation. The following remarks on the duty and work of central stations seem to us worthy of careful note:—

"Do you think, Mr. Edison, that electric lighting is advancing as rapidly in England and in Europe generally as it should?"

"No, I think the gas interests still have a lease of life. In my opinion, those who have had the making of the laws and regulations relating to the electric lighting industry, perhaps guided by the supply companies themselves, have managed to get it off the right track, and now nearly all the operating companies are on a wrong business basis for any rapid development. Nowadays the chief concern of the station manager is to grind out as much current as possible for every pound of coal he burns; he gets economical boilers, engines, and generators, and studies their arrangement; these are so near the practical limits of their perfection that only a 2 or 3 per cent. improvement can be expected, and so long as the station has a fair load, shows a good efficiency, and does not have breakdowns, everyone appears satisfied. The consumer grumbles at the cost of electric lighting, but pays his bill, the shareholder pockets the small dividend, and the manager is happy. They are selling current by Board of Trade units, although in competition with gas; it is *light* the public wants, not amperes."

"What changes, then, would you suggest?"

"It has been my pet idea ever since electric lighting started, for the operating companies to sell light, as it is here that the improvement is to be made and the grand financial incentive lies. Let them produce more light—more candle-power—per horse-power hour. I will grant the difficulty of fixing a 'unit of light,' but it is not necessary; it is an easy matter to charge from the meter indications for the lamp hours delivered. If the station simply receives payment only for watts delivered, it has no inducement to increase the efficiency of the lamp; they will even frown upon the inventor or lamp manufacturer who gives the consumers lamps taking half as much current, because it lessens their demand and the total consumption; in fact, it is to the station's interest to see lamps chewing as much current as the poor consumer will pay for. Again, on the other hand, lamp improvements are kept back because the efficient lamp is a short-lived one, and to educate the vast public to study their meter bills instead of their lamp bills is a slow and tedious process at best, and a herculean task at that. To an ordinary householder each 30 cents spent on a lamp-renewal is an evident out-of-pocket expenditure; his main idea is to get the lamp that requires replacement least often; he draws an analogy with the physiological truth, and decides that a 'short and merry' life of the wayward one costs him too much. It is the long-suffering lamp the public wants every time, and electric lighting drags along also."

"Do you ascribe the rapid development of central stations in America to a stricter adherence to the sale of light?"

"In part, yes; but here, of course, other conditions come in as well, although if you enquire of all the stations doing a remunerative business, almost without exception they are charging for light (lamp hours) and prefer to renew customers' lamps free of charge. There is Boston, as a typical example, where they have satisfactorily proved that it pays better to try and burn up lamps and remove those that won't give out. You see, then, every improvement in the lamps, either for life or efficiency, helps the station; it means increase of profits with the division in the shareholders' hands, and the public will not suffer, because it is doubly to the companies' advantage to lower the prices."

"What do you think caused Europe to adopt a current basis?"

"Well, in the old countries you find a sharper line of demarcation between types of men. You have the purely business man and the purely scientific man, and in commercial enterprises they do not always pull together as they might. In America, now, it may be our lack of development in either extreme which saves us, for our scientific men are in the field for business as well as glory, and the business man finds he also must possess some technical knowledge in order to keep up. At any rate I believe this 'combination man' is best suited to technical industries, and he is developed to greatest perfection in the States. Who is to blame, the business-man or the professor—for the conditions you can find in London of an alternating plant occupying a certain confined area, in which the copper put down in the transformers alone, leaving out any distributing wire, is over and above ample to have given a complete and magnificent system of distribution had a direct low-tension system been employed instead? Wasn't it a lack of unity?"

"I see you still stand up for the direct continuous-current systems, Mr. Edison."

"On this point I have never changed my ideas one iota. Alternating systems may have their field—they are explorative and, perhaps, a necessary development just now—but the cream of the electrical business is to be found in the large towns. I believe all these centres can be best supplied with direct low-tension three-wire systems. With the present 110-volt lamp we are able to give service within one mile radius, or, say, over an area of four square miles, and give sufficient incentive to improve the lamp. It will not be long before we have a 200-volt lamp as the working minimum, so that this same three-wire system can serve an area of sixteen square miles. The largest town would not want many such stations."

"Are you working in this direction now, Mr. Edison?"

"No, my energies are being exercised in other directions. In the early days I made a big fight to get the New York station started, and went right in to improve the incandescent lamp; we brought up its efficiency to eight and ten lamps, and ultimately to the present fifteen lamps per horse-power. On this basis the station pays well enough; but there is no reason why, with the necessary expenditure of time and money in experimenting, we cannot get to twenty-five or thirty 16 C. P. lamps, and at this figure I believe gas won't have another chance. I wanted to start stations in London on these possibilities, but did not get the encouragement I hoped for and the matter fell through. Yes, there is a grand field there yet."

ELECTRIC LIGHTING FOR SUMMIT, N. J.

The town committee of Summit, N. J., in the matter of electric lights, having received a number of sealed bids, carefully considered them, and decided that the only way to give all parties an impartial opportunity for receiving the award of the franchise would be to themselves specify the conditions under which a franchise would be granted. This plan was carried out. The conditions imposed cover the best points in all bids received so far, and provide for a bond of \$2,000, as evidence of good faith. Bids under this new arrangement will be received by the committee at a special meeting. Chas. E. Buckley, president of the Summit Improvement Company, which has entered a bid, stated to the committee that it was quite possible that his company would be able to lay all their wires under ground, provided the increased cost of so doing was not more than 25 per cent. greater than stringing them overhead. The franchise itself, however, when granted, will be of no practical value unless the consent of property-holders along the line of the proposed improvement be obtained. At least one large owner of property has publicly announced that his consent will not be given for the stringing of wires overhead.

DRY GOODS LAMPS.

A large "sell everything" store advertised recently a lot of incandescent lamps at 25 cents. At first blush, this would indicate that the day of universal electric lighting had been reached. But inquiry develops the fact that the store had bought a cheap lot of lamps for its own circuits, had found them bad, and was now working them off on the dear public.

ELECTRIC TRANSPORTATION DEPARTMENT.

THE ELECTRO-MAGNETIC TRACTION CO.'S UNDERGROUND RAILWAY SYSTEM.

That an underground conduit railway system, sufficiently simple to operate successfully in all kinds of weather and under great changes of temperature, is a great desideratum for large cities seems to be pretty generally acknowledged, and the greatest

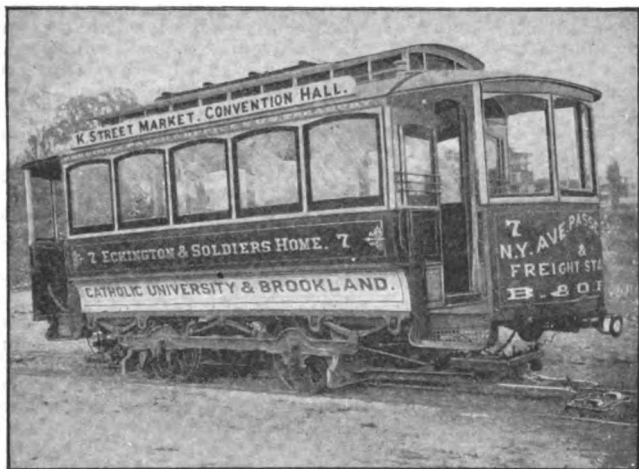


FIG. 1.

interest in the subject is being taken by electricians and capitalists alike. The recent paper by Mr. Joseph Sachs before the New York Electrical Society showed forcibly how many systems have been tried and how few are without some drawback which has proved fatal to their practical, commercial usefulness.

It is interesting to note that an entirely new system is now operating in daily service upon a branch of the Eckington and Soldiers' Home Railroad, about one mile in length, situated on North Capitol Street, Washington, D. C., which is said to fully comply with the three main requirements of an electric railroad, viz: Minimum first cost of construction, maximum economy in working, both of power and maintenance; and absolute safety to both passengers and general public.

The car, as shown in Fig. 1, has suspended from the under side of its truck, two iron bars, the same length as the car, hung upon light springs and adjustable by means of screws, known respectively as the energizing and collecting bars. Beneath one of the seats of the car is a small storage battery consisting of six cells,



FIG. 2.

arranged to give a current at a pressure of about eight volts, and connected to the energizing bar.

In the centre of the track are placed, at intervals of about 15 feet, hermetically sealed cast iron boxes, upon the lids of which are two raised surfaces, as shown in Fig. 2, known as the energizing and collecting plates, respectively, corresponding with the bars suspended from the car, which slide lightly upon them.

Securely attached to the under side of the lid of each cast iron

box is a simple electro-magnet, as shown in Fig. 8, wound with fine copper wire, one end of which is connected to the energizing plate. The free poles of the magnet hang down vertically and work in connection with an armature attached to a bridge piece. Upon this are two carbon faces, directly above each of which is a corresponding carbon face fixed to the slate bed of the magnet. One of the fixed carbon faces is directly connected to the main cable which conveys the 500 volt current from the generators at the power house. This runs in an iron pipe through all the boxes, as shown in Fig. 4, and the other carbon face to the collecting plate upon the box lid.

The operation of the car then becomes as follows: The battery discharges its low pressure current along the energizing bar through the corresponding plate upon the box lid to the electro-magnet, which, upon becoming energized, instantly attracts the armature and bridge piece, thus bringing all four carbon faces into close contact and completing the circuit, which allows the current to flow from the main cable up through the collecting plate to its corresponding bar upon the car and thence to the motors.

This applies only to single track. Where there is a double track the arrangement is somewhat modified, and in the new roads now under construction upon this system another novel feature has been introduced in the shape of a metallic return, which is effected by simply adding a third, or return, circuit bar

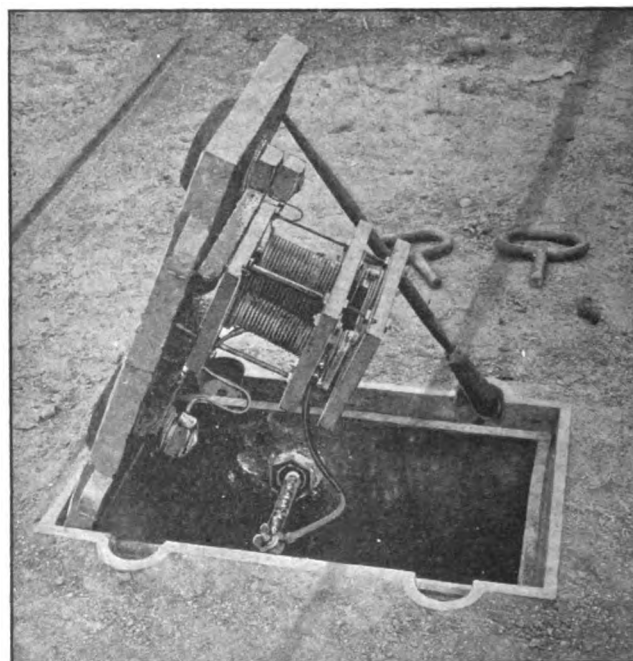


FIG. 8.

to the car and connecting a third contact plate with a return cable, laid in the same trench with the main cable. For double track the construction is as follows: The cast iron boxes, at the same distance apart as in the case of the single track, are placed between the tracks and the electro-magnets for both tracks are placed in the same box. The collecting, energizing and return contact plates are then set in the centre of the track in the same manner as illustrated for single track, with the exception that they are set upon blocks of either terra-cotta or granite, instead of upon the lid of the cast iron box, as shown. All the connections are made in a cast iron water-tight dish underneath the blocks and taken to the cast iron box between the tracks in an iron pipe. The advantages of the arrangement are manifold, not only reducing the cost of construction, but enabling the whole system to be installed without interruption to the traffic on the road.

The difference between the length of the collecting bars and the centre of the boxes insures good contact with the forward plate before the rear one is left. As proof of this, even when travelling at a considerably greater rate of speed than the city authorities allow, a steady and unflickering light is maintained in

the lamps of the car. Should any part of the electro-magnetic switch fail, it simply leaves the pins dead and the car has to drift by its own momentum to the next box. During the three months that the current has been on the existing road, no trouble has been experienced. From tests applied by the Wheatstone bridge after flooding some of the boxes with water while the car kept the switches closed, the leakage was found to be less than one-half of one per cent. of the power required per car. During snow storms the tracks will be kept clear of snow in the usual manner, and when frost after rain is expected, a car will be kept in operation to keep the contact plates clear of ice. The contact plates stand only about seven-eighths of an inch above the pavement, and offer, it is said, little or no obstruction to vehicles. The car has made 2,000 miles without an interruption or mishap and the steel collecting bars show no appreciable wear.

The cost of installing this system is about \$35,000 per mile of

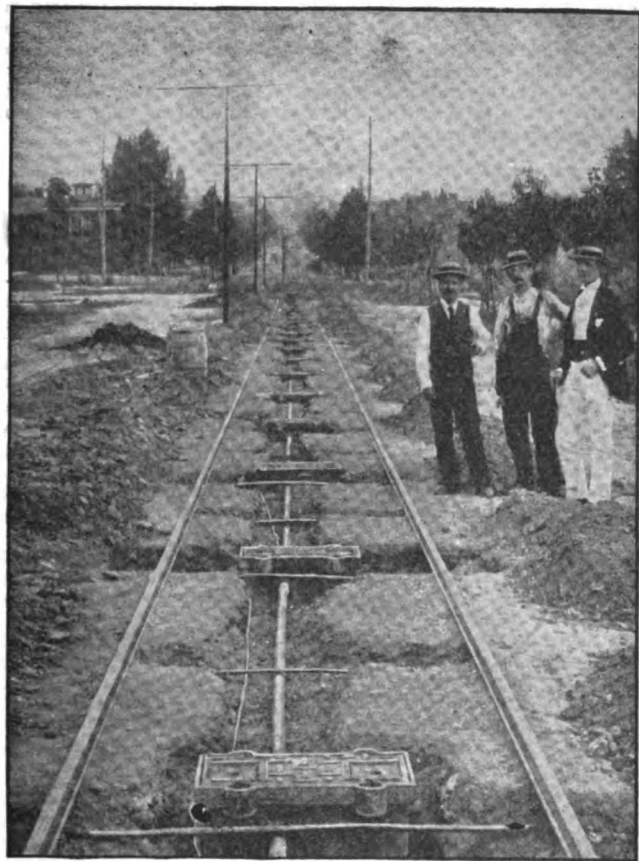


FIG. 4.

double track including the metallic return and all the cables, feeders and conduit.

The line now in operation was equipped by the Electromagnetic Traction Company, Corcoran Building, Washington, D. C., and the system is the invention of Mr. Malone Wheelless.

IS THERE A SOLUTION OF THE ELECTRIC CONDUIT RAILWAY PROBLEM?—III. DISCUSSION.¹

(Concluded.)

BY JOSEPH SACHS.

The discussion was opened by MR. TOWNSEND WOLCOTT, who objected to the three-wire system. MR. ALBERT STETSON said that an electric conduit, to be successful, must be cheap in order to compete with the cable. MR. C. B. FAIRCHILD, editor of the *Street Railway Journal*, doubted whether a conduit system is in demand or not, and quoted the opinions of certain companies to the effect that the adoption of such a system in a large city would be disastrous to the industry at large, because every little town would compel its local railway to follow suit, and thus nine tenths of the street railways in the country would be ruined. He then described the construction of the Metropolitan Street Railway Company of Washington, and stated that its cost was greater than that of cable construction. The latter in Washington costs

about \$86,000 per mile of single track, but ordinarily is about double this figure. The difficulty of maintaining a serviceable conductor was then touched upon. This is due to the presence of moisture and dirt. The speaker said that it was impossible to run an economical street railway with a 800 volt current. At least 500 volts is necessary, and 600 is often reached.

MR. R. R. LUNDELL favored the three wire system. He also spoke at some length of the Johnson-Lundell system in which sections of rail flush with the surface are energized. The slotted conduit, he said, is all right provided it is deep enough to suit the climate. In New York it must be deeper and better drained than would be necessary in Washington or in Europe. He was ready to put in his own system for \$30,000 per mile, double track. This includes simply the electrical equipment without rails or ties. The average voltage used with this system is 300. Mr. Stetson suggested that a pair of horses to draw the car back would be cheaper than to carry a large storage battery to provide for the connection when possibly it could be done away with. Mr. Lundell answered that the battery was never called upon except when it was needed, and that it required no attention whatever.

MR. C. J. FIELD spoke of relative cost of operation. In a good cable road this is about two cents per car mile, while that of electric roads of the best construction has now fallen as low as one cent, and even less. The conduit, he thought, was becoming necessary under certain conditions, though it would not drive out the trolley except in the case of a few cities in this country at present. Mr. Field spoke favorably of the Siemens & Halske and the Johnson-Lundell systems and did not think any open conduit would be successful without a double trolley wire.

MR. E. A. MERRILL deemed the balancing of the three-wire system a great difficulty. He then discussed the Johnson-Lundell system, and was answered by Mr. Lundell. Mr. Field, in answer to a question from Mr. Fairchild, spoke of one road, operating both cable and electric cars, where the expenditures are such that the former are about to be abandoned.

MR. SACHS, in closing the discussion, emphasized the fact that the conduit was expensive and only suitable for large cities. The insulators and conductors should be high and supported from the sides or bottom of the conduit. Surface leakage can be obviated by having a long surface and few insulators. The alternating system, he thought, was coming to the front. With the surface contact system he had found that the chief difficulty was uncertainty in the cutting in and out of the sections, and the action of the switching devices. He agreed with Mr. Field that where a conduit system is wanted, cost is no consideration. He thought, however, that the single conductor construction could be readily used by adopting the three-wire system. He thought that the question of the open slot conduit system rested mainly with the capitalist, and that it was this item of cost that had prevented thus far the installation of such a system in large cities.

IMPORTANT TROLLEY DEVELOPMENTS IN PHILADELPHIA.

The People's and Philadelphia Traction Companies have reduced fares to Germantown, a thickly populated suburb, to five cents, but the steam railroads have taken no action. It is contended by officials of both the Pennsylvania and the Reading companies that the travel which was diverted to the trolley lines when first started is now returning to the railroad companies, and up to this time it is considered that no necessity exists for reducing fares to the rates charged by competing trolley lines.

Another "ten-mile" trolley route will be opened, during next month, from Walnut street to Jenkintown. With the completion of the People's Line to Willow Grove, four miles beyond Jenkintown, a continuous ride on electric railways can be taken for about 85 miles, from Willow Grove to Marcus Hook.

PERMISSION TO BUILD A COMPETING LINE REFUSED IN NEW YORK STATE.

The New York State Board of Railroad Commissioners has denied the application of the Amsterdam, Johnstown and Gloversville Railroad Company for authority to build its proposed road. In its memorandum filed with the decision the Board says that the new road makes a saving of only two miles in the distance from Akin to Gloversville over the existing route of about sixteen miles by the New York Central road to Fonda, and from thence to Gloversville by the Cayadutta electric road. The Commissioners say: "In different reports from the time of its organization this Board has set forth certain evils that had been inflicted upon existing enterprises and upon the general community by the construction of unnecessary railroads. Such unnecessary railroads after a brief period of unwholesome competition, had speedily gone into bankruptcy and had finally become a burden upon the older projects and upon the general community. The evidence is undisputed that the existing roads are abundantly able to transact all business now offered or that is likely to be offered for many years to come. If the charges made for transacting

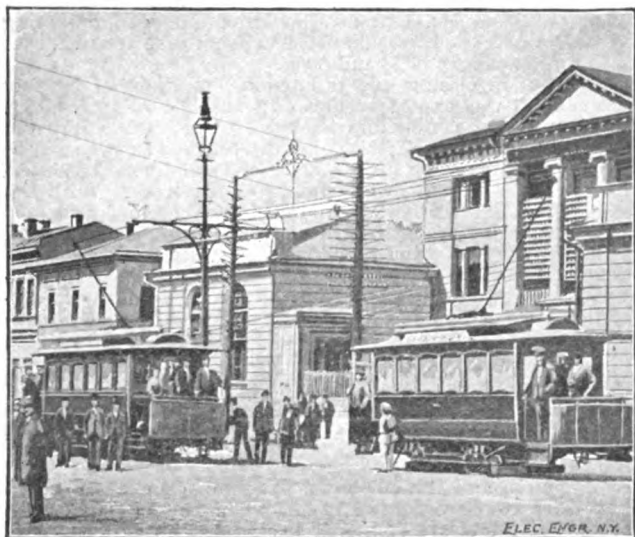
¹ Abstract.

such business are exorbitant there is a better method of curing this evil than by inviting superfluous competition. Furthermore, if the existing roads between Fonda and Gloversville are making exorbitant charges, this fact may indicate that there is hardly business enough to support them upon reasonable charges, in which case there is obviously no occasion to build another road in a neighborhood already oversupplied."

THE KIEFF, RUSSIA, ELECTRIC RAILWAY.

KIEFF, the capital of the Russian government department of the same name, is one of the oldest cities in the Russian Empire. It lies on the high bank of the Dnieper and is one of the principal centres of commerce and industry in southern Russia, having a population of 270,000. In 1890 a well-known Russian promoter obtained the franchise for the building of a network of street railroads in Kieff, and it is due to this circumstance that the city has obtained the distinction of being the first in Russia to be provided with an electric railway. Lying as it does on hilly ground, grades up to 10 per cent. are encountered, so that both steam and horse locomotion were practically out of the question, at least in some parts of the network; hence, while parts of the roads were equipped on the latter system, a particularly steep stretch from the Alexander Place to the Tsarskaja Place was equipped with electricity.

The electrical equipment was begun in October, 1891, and in May, 1892, the first trial trips were made. The regular operation of the road began on June 13, 1892, with four motor cars, which



THE KIEFF, RUSSIA, ELECTRIC RAILWAY.

easily overcame the grades, notwithstanding that the cars contained 50 persons while designed for only 32, and at a speed of 8 kilometres per hour. The financial results were not less gratifying, a good profit being shown. The receipts per car-verst for the year 1893 amounted to 78 kopecks, and the expenses to 31 kopecks.

The doubts of the city authorities having been dispelled by this fine showing, the remaining parts of the road were authorized to be equipped electrically, and during the whole of 1893 and 1894 this work has been going on. Five lines have been equipped thus far, $9\frac{1}{8}$ kilometers in length, with 14 kilometers of track. All the lines with the exception of one which passes through the main street, are single track. On this line the cars run on 4 minutes headway, while on the others they vary from 7 to 16 minutes. The tracks are laid with flat rails on wooden beams, which will probably be replaced by a stronger type of rail in the near future. The gauge is 1512 millimetres. The trolley wire is of silicon bronze of 6 millimetres diameter on the line first equipped, and of 7 millimetres on the later ones. On the double track line central poles with double outriggers are employed, to which also the arc lamps for street illumination are attached, as shown in the accompanying engraving. The single track lines are partly equipped with poles and span wires, and also with poles with side arms. The feeders are suspended on the poles, which, as a rule, are of wood, except on the main street, the Kreschtschatik, on which latticed iron poles are used. The current is returned to the station through a bare copper cable laid between the rails, and connected to the latter at frequent intervals. Iron bond wires span the rail joints.

As the equipment of the first section was more in the nature of an experiment, it was sought to keep down the expenses as far

as possible, and for that reason gas engines were employed to drive the generators. Twin Otto gas engines of 60 H. P. drove two dynamos, delivering 60 amperes at 500 volts. This plant, however, has been enlarged with a steam outfit, the gas engines being held in reserve. The new power station is a one-story, massive building, at present equipped with three steam engines and three boilers, with room for an additional engine and boiler. Babcock & Wilcox boilers are used and the engines have a maximum capacity of 230 H. P. The engines take the condensing water from a pipe leading to the River Dnieper, the level of which at low water is 18 metres below the foundation of the power house, the condenser being placed in a shaft at the corner of the boiler house, so that the lift of water shall never exceed 6 metres at the lowest tide.

The present equipment consists of 32 motor cars and the old horse cars are employed as trailers on the stretches having the least grade. The first 6 motor cars put in operation have room for 20 passengers seated and 10 standing, while the newer ones have seats for 22 and standing room for 18. Each of the motor cars is equipped with two motors. The plant was furnished by the Allgemeine Elektrizitäts Gesellschaft, of Berlin. In addition to the hand brake they are equipped with an electric emergency brake, by which the motor is converted into a dynamo, and for a particularly steep part of the Alexander line a few cars are also equipped with track brakes.

ELECTRIC TRACTION FOR STATEN ISLAND.

The Staten Island Midland Railway Company's West Brighton branch and the Port Richmond and Prohibition Park Electric Railway Co. have been consolidated, for the purpose of constructing and operating an electric road from the West Brighton station of the Staten Island Rapid Transit, through Broadway, Castleton avenue, Columbia street and the Manor road as far as Eckstein's Brewery, with an extension from Castleton Corners, over the Richmond Turnpike to Jewett avenue and down Jewett avenue to the terminus of Port Richmond and Prohibition Park Electric Railway, thus forming a complete horseshoe, with one end resting in West Brighton and the other in Port Richmond. This will make easy of access the most desirable part of the interior and upland portion of Staten Island which commands a magnificent view of the upper bay, the cities of New Jersey and the Orange Mountains.

The connection of the road by the Bergen Point Ferry, with the Consolidated Traction Company offers a convenient route to Newark, Jersey City and the intervening Jersey towns from the interior of the island.

The terms of the consolidation are not yet made known, but operations will at once be begun provided the weather does not interfere. It is understood that the present power plant and rolling stock equipment (Edison System) of the Port Richmond road will be utilized with such extensions and additions as may be required. Mr. F. R. Chinnock of this city is Supervising Engineer.

STEEL RAILS FOR YONKERS.

About 350 tons of new steel rails for the Yonkers Electric Railroad Company have arrived from Johnstown, Pa. They are intended for Park and Warburton avenues. The work of laying them in Park avenue has been begun and it is hoped they will all be laid before cold weather sets in.

ELECTRIC TRACTION FOR CUBA.

An English company is arranging to run an electric tramway in Havana. The tramways at present existing there and in the suburbs are owned by a company called the Ferro Carril Urbano, and comprise a steam tramway from Havana to Vedado, a suburb three miles distant on the seacoast and three lines of horse car to Castillo del Principe, Cerro and Jesus del Monte. The fare is 5 cents or 10 cents according to distance. The projected electric line is 20 miles long, and its chief object is to connect the principal thoroughfare and wharves with the other tram lines in the city. M. M. Sanchez, a banker and broker of 18 Wall street, is interested, it is said.

BALTIMORE LONG TROLLEY ROADS.

In less than a year, if the present plans carry, Baltimore will be connected with Washington and Gettysburg by electric railways. The company that will build the road to Washington has advertised for bids for constructing 16 miles of double track road from Washington to Laurel. The entire line is to be completed within a year. The specifications provide that the road shall be laid with 80-pound steel rails and shall be so ballasted and constructed as to permit electric trains to attain a speed of 60 miles an hour. Three steel bridges, one of 100 feet and two of 50 feet, are also included in the specifications. These are to span the water courses which the road will cross. Contractors are also to

submit bids for two power-houses in which to generate the electric current to be used in propelling the trains. One of these power houses is to be located at or near Laurel, and the other at some point to be selected by the company between that place and Washington.

The Elkins-Widener street railway syndicate are interested largely in both projects. The Washington road and the Gettysburg line will connect with their suburban lines extending from this city. The system of turnpike roads between Baltimore and Gettysburg provides nearly an air-line for the electric road.

A LONG ELECTRIC ROAD FOR INDIANA.

The Grant county commissioners, of Indiana, have granted the Indianapolis, Anderson, Alexandria and Marion Electric Railway a franchise for Grant county. The road is to parallel the "Big Four" road from Indianapolis to Marion. The company has filed a bond in the sum of \$5,000 to begin work not later than June, 1895, and to complete the road in October.

ALLEGED ELECTRIC RAILWAY BRIBERY AT NEW BRUNSWICK, N. J.

The Board of Aldermen of New Brunswick, N. J., has passed a resolution authorizing the appointment of a committee of three members of that body to investigate the rumors charging that board with corruption in relation to the passage of the electric railway ordinance recently. The committee will have the power to subpoena any persons to appear before them. It was intimated at a recent meeting of the City Club, that money had been brought into New Brunswick to accomplish the purposes of the city railway.

THE CLEVELAND AND ELYRIA ELECTRIC ROAD.

The Cleveland and Elyria Electric Railroad Company has been incorporated, by Messrs. F. T. Pomeroy, M. A. Sprague, A. W. Bishop, C. W. D. Miller, Leon M. Coe, Will Christy and A. H. Pomeroy. The capital stock is \$200,000. It is proposed to construct and operate an electric railway, single or double track, which shall carry packages, freight, United States mail, express matter, and baggage, as well as passengers, and have the privilege of furnishing electricity, to be generated by either steam or water power for light, heat, or power along its line. The route will begin in the city of Cleveland and run westerly through the counties of Cuyahoga and Lorain to Elyria, with branches to the cities of Wellington and Oberlin. The headquarters of the company are to be at Berea.

CAMDEN'S BELT LINE TROLLEY.

A big gang of men have started work rebuilding the Delaware avenue connecting road for the Camden, N. J., Horse Railroad Company's trolley lines. The connecting road is two blocks long, running along Delaware avenue from Market to Federal street. It has been used for years simply as a means of running horse cars from Market street to Federal, in order to reach the South Camden Car Depot, but it will now be put into active use as a trolley road. When the Pennsylvania Railroad Company builds the proposed double ferry house and great central depot on the river front between Federal and Market streets this route will become one of the busiest in the city. It is also stated that when the work of trolleying the North Second and Third street lines is finished one of the southern lines will be run up by that route, thus making a belt line road, taking in all the ferries at Kaign's Point, at Market street, Federal street and Cooper's Point, in a continuous run. Many improvements are contemplated by the company in the near future, but President Soull says their plans are not sufficiently matured to make public at present.

SUCCESS OF THE NIAGARA FALLS PARK AND RIVER TROLLEY RAILWAY.

The Niagara Falls Park and River Railway has had a very prosperous season in spite of the depression which that section of the country has shared with the rest. Up to the end of October, 1893, the road carried 406,700 passengers, while this year the number has risen to 467,304, and this in the face of a decrease of 33,000 in the month of October '94, as compared with '93. The reason for this is that the October weather was very threatening and there were no returning tourists from the World's Fair as in the previous year. A very large amount of advertising has been done, the road has been most extensively talked about, and all the passengers have been carried without a hitch, all of which will have a tendency to make 1895 a record year. During this time only one casualty has occurred, and that through no fault of the company. The road has been visited by a very great number of prominent people of Canada and the United States. Perhaps

the most notable car load consisted of the Secretary of State; Secretary of the Treasury; Secretary of the Interior; Secretary of the Navy, and the Secretary of War, with their wives, the Postmaster General and a number of the other dignitaries of the United States Government.

An addition has been made to the length of line, a mile and a half of track having been built south from Chippewa to Slaters Point directly opposite Navy Island. A regular connection was also made for about three months with Buffalo, by the steamer "Columbian." This new route to Buffalo became very popular towards the close of the season, and will be a very valuable feature next year. The company has also completed the erection of extra car houses and a repair shop. These are located close to the Whirlpool and are comprised in a building 250 x 60 feet.

BALTIMORE TROLLEY EARNINGS.

The earnings of the Baltimore Traction Company are daily increasing, and the management has instituted a system of rigid economy, without in any way affecting the efficiency of the system, and the net results are very satisfactory. The company earned in October, \$89,989.56 gross, against \$88,765.56 for the same month last year, and the net earnings show an increase of \$12,490.

BROOKLYN TROLLEY CO.'S TRANSFERS.

A very extensive system of transfers for one fare has been carried out by the Brooklyn Heights Railroad Co. Mr. D. F. Lewis, the president, expresses the belief that if the railroad companies could be "intelligently encouraged by allowing them to receive an additional fare of three cents," the Brooklyn Heights Company could afford to largely increase its transfer system and save people money.

NEWARK, N. J., TRACTION PEOPLE WILL APPEAL.

The Consolidated Traction Company will at once appeal from the decision of the Supreme Court of New Jersey, depriving the corporation of the use of five miles of streets in the heart of Newark. General Manager David Young said last week that A. Q. Keasby, attorney for the traction syndicate, had been instructed to prepare the appeal papers for presentation at the next session of the Court of Errors and Appeals. Mr. Young said that the decision given if not reversed, would injure the syndicate to the extent of \$100,000 in anticipated revenues from the proposed extension of its tracks.

THE BETHLEHEM AND NAZARETH ELECTRIC STREET RAILWAY.

A charter has recently been granted to the Bethlehem & Nazareth Electric Street Railway Co., of Bethlehem, Pa., to build a road between the two boroughs. It will run from the intersection of Broad and Main streets in Bethlehem, over the Nazareth road, through the townships of Bethlehem and South Nazareth in Northampton County to the public square in Bethlehem, a distance of ten miles in an almost straight line. There are no grades and no bridges, and the work will consist simply of track laying from start to finish, fifty pound T-rail being used.

At Bethlehem the line will connect with that of the Lehigh Valley Traction Co., a forty mile road in successful operation through a country with a population of over 60,000. Power for the new road will be rented from convenient electric plants. The Hon. Charles Broadhead, of Bethlehem, is president of the company.

ELEVATED VS. TROLLEY IN NEW YORK AND BOOKLYN.

THE ELECTRICAL ENGINEER has already referred to the falling off in the traffic of the elevated roads in this city, due, principally, to the competition of the Broadway cable line. The annual report of the railroad commissioners shows that where elevated roads have come into competition with the trolley, the former have fallen even further behind. This is strikingly noticeable in the case of the Brooklyn roads. The Brooklyn Elevated Company reports that it carried during the year ending Sept. 30, 84 283,697 passengers against 38,110,376 in 1893. Its gross earnings were \$1,755,262 against \$1,935,683 the preceding year. The Kings County Elevated Company carried 14,472,150 passengers, against 13,544,033 in 1893. Its gross earnings amounted to \$742,230 against \$941,620 in 1893.

The surface roads have gained during the year in passengers carried in Brooklyn as follows:—

	1894	1893
Atlantic Avenue.....	18,331,745	16,464,173
Brooklyn, Bath & West End.....	1,545,545	1,169,781
Brooklyn City and Newtown.....	14,664,033	11,994,773
Stenway.....	8,580,860	3,362,501

THE ELECTRICAL ENGINEER.

[INCORPORATED]

PUBLISHED EVERY WEDNESDAY AT

303 Broadway, New York.

Telephone: 1323 Cortlandt.

Cable Address: LENGINEER.

Geo. M. Phelps, President.

F. R. COLVIN, Treas. and Business Manager.

Edited by

T. CONNERFORD MARTIN and JOSEPH WETZLER.

Associate Editor: GEORGE B. MULDAU.

New England Editor and Manager, A. C. SHAW, Room 70—680 Atlantic Avenue, Boston, Mass.

Western Editor and Manager, C. KAMMEYER, 1439 Monadnock Building, Chicago, Ill.

New York Representative, 208 Broadway, } W. F. HANES.
Philadelphia Representative, 916 Betz Building, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada, - - - - - per annum, \$3.00
 Four or more Copies, in Clubs (each) - - - - - 2.50
 Great Britain and other Foreign Countries within the Postal Union " - - - - - 5.00
 Single Copies, - - - - - .10

[Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1893.]

VOL. XVIII. NEW YORK, NOVEMBER 28, 1894. No. 848.

CONTENTS.

EDITORIALS :—	PAGE
Swiss Central Station Statistics	438
Current vs. Light.....	439
ARTICLES :—	
The Wood Arc Light Transformer (Illustr.).....	439
Electrical Machinist Practice.—XI. (Illustr.).....	J. F. HOBART. 439
The Early Morning Test in Telephone Offices (Illustr.).....	J. W. MANSON. 431
The Kearney, Neb., Water Power (Illustr.).....	432
Mr. Edison on the Work of Central Stations.....	433
Sampson Combined Curb and Conduit System. (Illustr.).....	440
Electricity on Shipboard.—II. (Illustr.) (Concluded).....	S. D. GREENE. 441
ELECTRIC TRANSPORTATION DEPARTMENT :—	
The Electromagnetic Traction Company's Underground Railway System (Illustr.).....	434
Is there a Solution of the Electric Conduit Railway Problem?—III. Discussion. (Concluded.).....	435
Important Trolley Developments in Philadelphia—Permission to build a competing line refused in New York State.....	435
The Kieff, Russia Electric Railway. (Illustr.).....	436
Electric Traction for Staten Island.—Steel Rails for Yonkers.—Electric Traction for Cuba.—Baltimore Long Trolley Roads.....	436
A Long Electric Road for Indiana.—Alleged Electric Railway Bribery at New Brunswick, N. J.—Cleveland & Elyria Electric Road.—Camden's Belt Line Trolley.—Success of the Niagara Falls Park and River Trolley Railway.—Baltimore Trolley Earnings.—Brooklyn Trolley Company's Transfers.—Newark, N. J. Traction People will Appeal.—Bethlehem & Nazareth Electric Street Railway.—Elevated vs. Trolley in New York & Brooklyn.....	437
NEWS AND NOTES :—	
Electric Lighting for Summit, N. J.....	438
Dry Goods Lamps.....	438
No Resuscitation from Gerrycide.....	440
Shading Lights not Paid for.....	443
Power Lost in Indicating Instruments and Switches.....	443
New York Board of Electrical Control.....	443
Why not Use Decent Brakes.....	444
A Municipal Plant for Lisbon, Iowa.....	444
Receiver for the Neptune Electric Co., of Asbury Park, N. J.....	444
SOCIETY AND CLUB NOTES :—	
American Institute of Electrical Engineers.....	442
Telegraphers' Mutual Benefit Association.....	442
National Electric Light Association.....	442
PERSONAL :—	
Mr. Addison G. Waterhouse.....	442
EDUCATIONAL :—	
Electrical Course for the New York Y. M. C. A.....	442
Free Lectures to the People of New York.....	442
LITERATURE :—	
Trowbridges "Three Boys on an Electrical Boat.".....	443
Dickson's "The Life and Inventions of Thomas Alva Edison.".....	443
"The Electrician", Electrical Trades Directory and Handbook.....	443
INVENTORS' RECORD :—	
Classified Digest of U. S. Electrical Patents Issued Nov. 13, 1894.....	444
LEGAL NOTES :—	
Edison Electric Light Co. vs. Sunbeam Lamp Co.....	444
TRADE NOTES AND NOVELTIES AND MECHANICAL DEPARTMENT :—	
The De Rycke Condensing Exhaust Pipe. (Illustr.)—The Falkenau Engineering Co., Philadelphia.—Elmer G. Willoughby & Co.....	445
Packard Vacuum Pump. (Illustr.)—The New Westinghouse Works—Goulds Mfg. Co.—Van Vleck Service End Cutout. (Illustr.)—Dick & Church Engines.....	446
Allgemeine Electricitäts Gesellschaft.—Triumph Electric Co.—Electric Supplies for the Government Proving Grounds.—Contract Awarded for Battery Supplies.—75,000 German Lamps.—Western Notes.....	447
Westinghouse Ornamental Lamp Bulbs.—New York Notes.—New England Notes.—Philadelphia Notes.....	448

SWISS CENTRAL STATION STATISTICS.

SOME months ago we had occasion to draw the attention of our readers to the statistics of German electric central stations, in which we pointed out the minuteness with which these reports were made out and the excellent basis which they formed for the drawing of conclusions as to questions upon which the very life of a central station depends. To be sure, one of these reports gave the statistics of only 21 stations, but they were all of such a representative character and varied so much in details of their operation that they formed a most excellent basis for a comparison. We have before us a compilation issued as the Year Book of the Swiss Electro-Technical Society, which contains statistics of electrical work in Switzerland up to June 1, 1894. The statistics contained in this work, in so far as they refer to electric lighting and power distribution, are as complete as any which it has been our good fortune to encounter, and the result is that one is able to draw some pretty fair conclusions as to the trend of opinion and work in electrical matters in the country which has been called the electrical centre of Europe. The numerous waterfalls existing in Switzerland have, of course, greatly aided the introduction of electrical distribution in Switzerland; thus, of the 79 central stations included in the statistics, 72 are driven by water power, 1 by water and petroleum engine, 3 by steam, 2 by electric motor, and 1 by water and steam. Yet it would be erroneous to suppose that the steam engine is crowded into the background and that the progress noted is due to the available waterfalls alone. Thus, during the year 1893, the relative proportion of the various types of motors employed for driving dynamos for private electric lighting plants, was as follows: Hydraulic motors, 51.6 per cent.; steam engines, 36.2 per cent.; gas engines, 8.7 per cent.; petroleum and benzine motors, 1.4 per cent.; electric motors, 2.1 per cent.

It deserves to be remarked that in isolated plants very good results have been obtained with petroleum engines in connection with storage batteries. Of the 24 new power transmission plants installed in the year 1893, 16 employed the continuous current, 1 the single-phase alternating current induction motor; 1 the two-phase alternating and 6 the three-phase alternating current. Two electric railroads were also built during the year, aggregating 7.5 kilometers in length. Electric motors are constantly gaining in favor and during 1893, 99 such machines, with a total capacity of 650 H. P., were connected up to existing light and power distribution systems. It is interesting to note that of these, 31 were continuous current, 23 single-phase alternating, 4 two-phase, and 41 three-phase machines. Unfortunately, the capacity in horse power of each of these various types is not given, but the significant fact nevertheless remains that nearly one-half of the total number of motors installed during that year employ three-phase current. The owners of Swiss electrical plants are gradually coming to the conclusion, long since reached in America, that, both in regard to the rational working of and the income derived from the stations, as well as in view of the demands of the public, power distribution is at least of fully as great importance as that of light distribution; and that, though the quality of the light may be somewhat

deteriorated by the connection of motors to the circuits, that disadvantage is largely overbalanced by the reduction in the lighting charges and by the increase in the subscribers thereby brought about.

Of the 116 electric light plants installed in 1893, not less than 40—that is, 37 per cent.—were equipped with storage batteries. This extraordinarily high percentage proves once again that the advantages of the accumulator which we have so strenuously insisted on in these columns, are more and more appreciated, and that the Swiss public has great confidence in this valuable auxiliary to electric lighting plants. It shows conclusively that the durability of the plates is such that the battery can, without hesitation, be placed in small installations which are not supervised by an expert. It must not be supposed, that the long distance, high potential transmissions in Switzerland are exclusively carried out by means of the alternating current; for among the power plants installed last year was one in which the continuous current was employed at 7,000 volts pressure, transmitted over a line 18 miles in length. The following brief table will show the exact condition of electric lighting and power work in Switzerland at the end of the year 1893, and presents a most encouraging prospect :

	1893.	1892.	Increase over 1892.
Lighting Plants.....	677	351	35.6
Power Transmission Plants.....	77	25	46.2
Storage Battery Plants.....	161	41	83.3
Dynamos and Motors.....	1407	536	40.8
Total Capacity in K. w.....	28881	7060	37.8
Incandescent Lamps.....	145949	51155	32.0
Arc Lamps.....	2126	845	30.0

Included in the report which we have just been analyzing is a table giving the complete statistics, covering motors, generators, potential, system of conductors, accumulators, transformer stations, incandescent and arc lamps, etc., of every central station in Switzerland, and also a detailed report of the largest central station in Switzerland, that installed by the City of Zurich, which in every way is a model of clearness and in which nothing which could add to the value of such a report has been neglected. Lack of space prevents us from entering into the many interesting details brought out by this report, but one of the results is worthy of special remark, and this relates to the efficiency of the plant as a whole. While tests show that, with the large alternators at the station, fully loaded, an efficiency of 91 per cent. is obtained, and while the mean annual efficiency of the transformers was shown to be 80 per cent., nevertheless, the combined mean annual efficiency of generation and distribution of the current including the losses in turbines, etc., amounted to only 45 per cent !

It would be interesting to know just what percentage of the power shown by the indicator cards of our central stations is actually paid for by the consumer in the form of current.

Two methods of charge are employed at Zurich, one by the meter, the other by flat rate. Deducting the number of hecto-watt hours paid for by meter from the total number of hecto-watt hours delivered by the station, it is found that the amount of current consumed by flat-rate consumers showed a discrepancy of only 4 per cent. when reduced to meter rate figures. This certainly speaks well for the conscientiousness of the Swiss in carrying out their agreements with the lighting company, but it would be dangerous to apply that rule universally. The cost of

generation per hecto-watt hour, including all rebates and writing-off, amounted to 9.8 centimes, whereas the charge to the consumer was 7 centimes, plus 10 francs per year per lamp for every lamp installed, with a rebate of from 3 to 15 per cent. for all bills from 500 to 4,000 francs, or more. These figures show that without the fixed charge of 10 francs per lamp installed, the financial balance of the station would have been on the wrong side. This may be a hint to not a few electric lighting companies in the United States.

CURRENT vs. LIGHT.

ALTHOUGH Mr. Edison has professedly withdrawn from active work in the field upon which he stamped his genius he has evidently kept pretty close track of what is going on in electric lighting and his views on some of the burning questions of the day are worthy of the fullest consideration. In the interview with him which we print on another page it will be noted that he traces the slow progress of English incandescent lighting to the basis of charge now generally employed. He would not charge for current, but for light, and believes that the charge for *watts consumed* is largely responsible for the poor results obtained in central station profits. The aim of the station manager to grind out a lot of current to be registered on the meters makes him slow to adopt the highest efficiency lamp and hence the customer plodding along with an old low efficiency lamp, not only gets a poor light but is paying for current which would bring probably twice the number of lamps to full brilliancy. The remedy for this state of affairs Mr. Edison sees in the adoption of a high efficiency lamp and the *lamp-hour* basis of charge. While the latter is more a question of expediency and to some extent of convenience, and therefore open to argument, there can be no question as to the soundness of the proposition that the high efficiency lamp is the most economical from the standpoint both of the consumer and of the central station. We need not again quote the figures to prove that it pays to smash an incandescent lamp long before its filament breaks, but there are many persons, it seems, who still cling fondly to the belief that a lamp ought to be kept on the circuit as long as it can be distinguished in the dark,—and then they wonder why the station does not pay. Mr. Edison again hints at the possibility of a 200-volt lamp and what such a lamp would mean to electric light distribution. Lamps of 150 volts have come into use to some extent on the continent of Europe but the slowness of their general adoption is perhaps due to causes not dependent on the qualities of the lamp. "High efficiency," however, is the watchword of the present. In this connection it may be of interest to note the rumor that a large consignment of incandescent lamps of German make is on the way to these shores, to be offered for sale in competition with our own. If, after paying a duty of 35 per cent., these lamps can compete with American lamps in price, quality and efficiency we shall welcome them as we welcome anything which will contribute to better electrical service; but we may be pardoned for expressing some doubts on this point. We are strengthened in this scepticism by reading the advertisements in our English contemporaries in which prominence is given to the fact that the lamps offered are "not made in Germany." England some time ago was flooded with German lamps, but they were found to be sadly wanting. We have no doubt that the Germans can and do make good incandescent lamps, but at the prices which will have to be met here, with the added duty, it seems hardly possible that the desired quality can be attained with any reduction of price below that at which really good lamps are now to be bought here.

THE SAMPSON COMBINED CURB AND CONDUIT SYSTEM.

WHILE the question of underground conduits has received considerable attention from inventors and engineers, it must be admitted that a conduit combining all desirable qualities and being entirely free from objectionable features, does not yet exist.

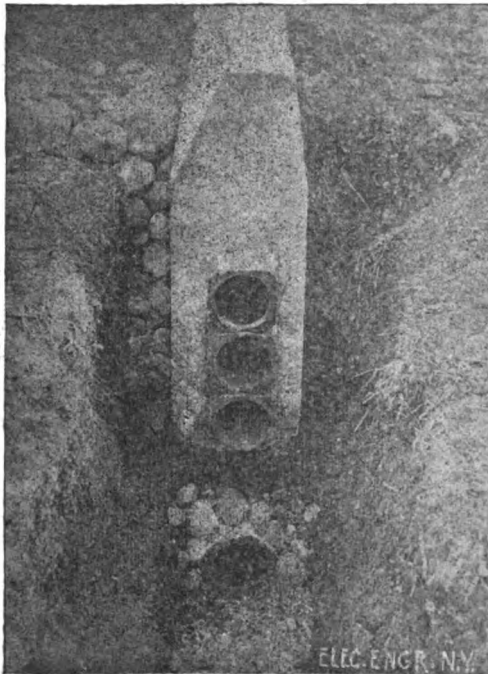


FIG. 1.

The conduit system illustrated in the accompanying engravings will be found to show a marked advance in the art and to embody nearly all the features desired by the electrical engineer in a complete conduit system for electrical distribution.

As indicated in the name, the conduits are embodied in the curbs, leaving the middle of the streets in possession of gas, water and steam pipes. Referring to the illustrations, Fig. 1 is an end view of the conduit showing position of drain pipe underneath; Fig. 2 shows the methods of placing the curb sections in position,

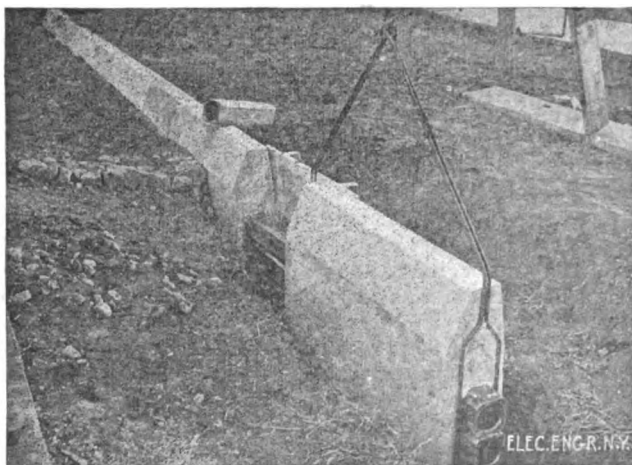


FIG. 2.

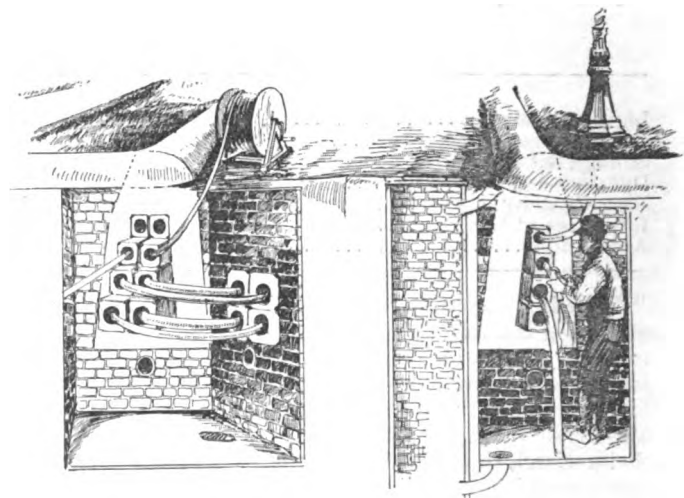
while Figs. 3 and 4 show details of manhole construction at street corners.

In placing the Sampson combined curb and conduit a trench of suitable width and depth is dug along the curb line of the street, and wholly outside of the driveway, so as not to disturb the paving of the street except at crossings. The old curbing is removed, and the trench thoroughly flushed and tamped. A three-inch drain tile is then laid to the necessary grade and surrounded with sufficient gravel or crushed stone to a depth of 10 inches.

The gravel or stone should be well compacted around the tile, and the tile connected to the catch basins. The conduit, which is made of vitrified tiles laid in concrete and furnished in sections of four feet containing as many ducts as desired, is now placed on top of the gravel, the sections two feet apart, and is lined up and tamped tight. The ducts of the two adjacent sections are then joined together by tiles, kept in position by a mandrel pushed through the ducts; a sheet steel frame or mould is placed from section to section on the outside, and a mixture of concrete and Portland cement cast around the tiles, securing a perfect air and water tight joint, and finally the curb is faced with cement and sand and dressed smooth with trowel and brush. At such points as may be desired a T-shaped tile or duct is laid for house or street lamp connections, and all ends are sealed with plugs until such time as connections are to be made. At street corners and at such other points as a change in grade or in the alignment of the curb may necessitate, manholes are built of sufficient size to permit the drawing, splicing and tapping of cables.

The drainage of the conduit system is provided for by means of suitable tile connections from the floor of the manholes to the sewer system, and ventilation is obtained through the manholes and ducts running into the lamp posts. For crossing streets the conduit would be constructed in the same manner as the combined curb and conduit with the difference that no part of it would be brought above the surface of the street.

It is evident that this system has several advantages. The material used is practically indestructible, the vitrified pipe is a good insulator, impenetrable to water, and the smooth glazed surface offers a minimum resistance to the drawing in of cables. All connections, both for house and street lighting can be made without disturbing the street pavements, T-branches with ample hand room being placed at intervals of 25 feet. In addition to the system being entirely out of the way of gas and water



FIGS. 3 AND 4.

pipes, the subdrainage of the curb is of great advantage to the road bed, especially on unimproved streets.

The cost of this conduit system is said to be no more than that of ordinary curb and corresponding pole lines. The system can also be adapted for the business portion of the city by combining the conduit with an area wall, built similar to the curbstone.

The above described design of the new conduit system is intended principally for the residence parts of large cities, and has been adopted by the Norwood Park Electric & Construction Co., which has purchased the patent rights for Norwood Park Ill., and will utilize it exclusively in the construction of its electric-light distribution system. The conduit is being exploited by the Sampson Conduit Construction Co., of Norwood Park, Chicago.

NO RESUSCITATION FROM GERRYCYDE.

In reply to a communication from Gov. Flower in regard to the proposed attempt to resuscitate a convict put to death by electricity, the New York attorney-general says:—

The provisions of the law pertaining to the death penalty and the method of inflicting that penalty are familiar, and are, in substance, that the punishment of death must in every case be inflicted by a current of electricity of sufficient intensity to cause death, and the application of such current must be continued until such convict is dead. The words of the statute are so clear and explicit that electricity must be so applied and continued as to deprive the convict of life, that there is no necessity of any

comment upon the language used. In my judgment, neither the Governor or the state, the superintendent of state prisons, nor the warden of Auburn prison, has authority to deliver the body of a convict after the execution of the death penalty and a post-mortem examination to Dr. Gibbons or any other individual not a relative of the person executed. If the body is not claimed by a relative, it is the duty of the authorities in charge to bury it, and not to deliver the body to any individual for the purpose of experiment.

ELECTRICITY ON SHIPBOARD.—II.

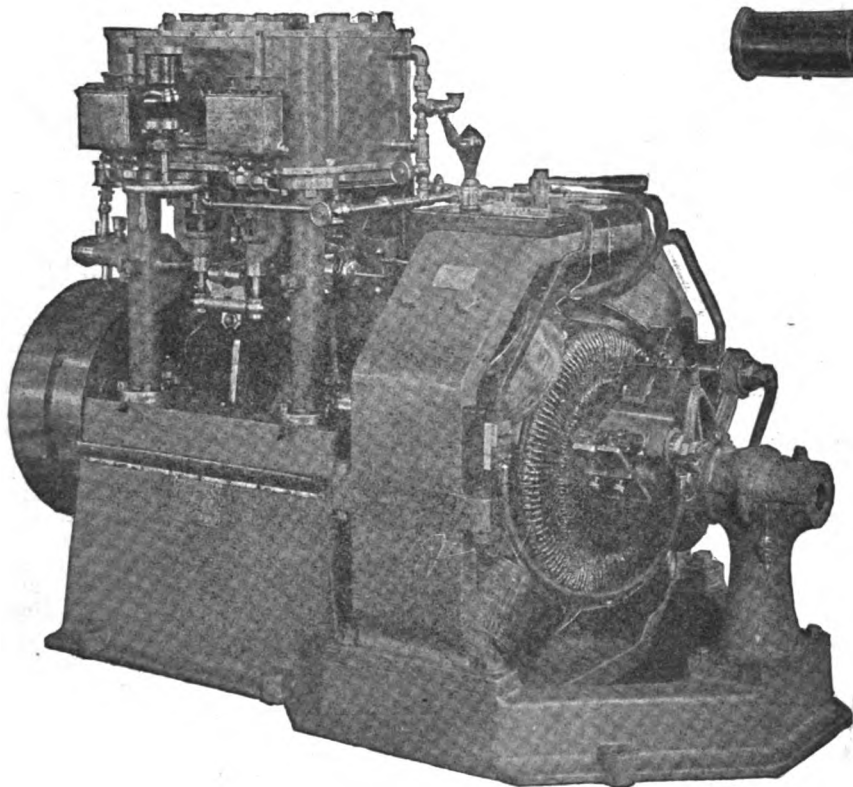
BY S. DANA GREENE.

(Concluded.)

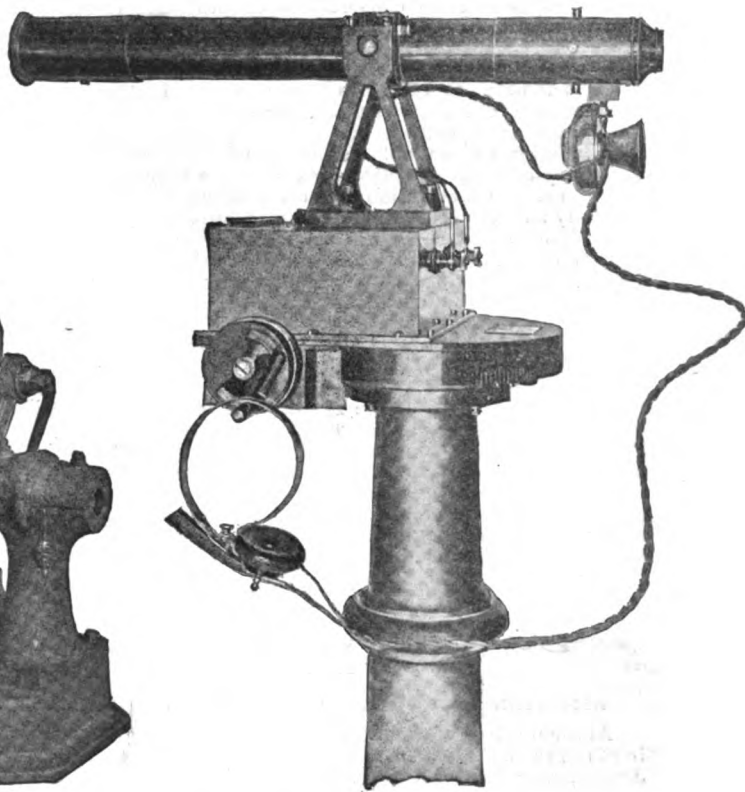
For night signals, the Navy has recently adopted an improved form of the Ardois system, suggested by Lieut. A. P. Niblack, U. S. Navy. Four double lanterns, each lantern being colored half red and half white, are strung on a jackstay at the mizzen-mast, the interval between the lanterns being 12 feet. An incandescent lamp is placed in each half of each lantern and connected by cable to a signal stand mounted on deck as desired. Various combinations of red and white lights are then flashed by a switch at the signal stand and the lights are burned until the signal is reproduced on all the answering ships. Another switch is used

invention of Rear Admiral Fleuriat. A set of revolving vanes on the log impart, through worm gearing, motion to an ivory disc mounted in the log, and a spring makes contact with metallic plates placed at intervals on the rim of this disc. As this contact takes place, a bell is sounded aboard ship, once for every 24 revolutions of the vanes. The interval between signals is arranged 11 seconds for 8 knots, 8.8 seconds for 10 knots, 4.4 seconds for 20 knots, and is, therefore, of sufficient length to prevent errors. To indicate fractions of a second, the usual sand glass has been displaced by a pendulum indicator which beats at intervals of two tenths of a second, and which is started at the moment of taking an observation. A mistake of half a second, with a period of 50 seconds, makes an error of only one-tenth of a knot in the speed of the vessel; if the observation is prolonged, the error is reduced. The apparatus is simple, and apparently gives good satisfaction. The log is about 9½" in diameter and is not watertight.

Another French invention, by Lieut. Bersier, of the French Navy, which will probably be introduced aboard ship, is the steering compass. Its object is to keep a ship on her course automatically and without the constant manipulation of the wheel in the hands of the helmsman. The following brief description of the device is taken from a recent technical journal. The electric spark of a Ruhmkorff coil is made to unite a pointer on the circumference of the compass card with either one of two semi-cylindrical, metallic plates, which are electrically insulated from



DIRECT COUPLED MARINE LIGHTING PLANT.



FISKE RANGE FINDER.

to "blink" the upper light, thus indicating some special code signal. This system is rapid and very satisfactory up to distances of three to five miles. For "wig-wag" signalling, between two vessels, a very neat double masthead lantern has been developed, the red and white lights being flashed in succession by a key. A "multiple fibre" incandescent lamp has been recently brought out in England for use with these masthead lanterns, the individual fibres, or filaments, being so fine that they lose their incandescence immediately the current is cut off. With the usual single filament lamp, there is an after-glow, when the circuit is opened, which is sometimes confusing in rapid signalling. The search light provides an excellent means of long distance signalling, the beam of light being thrown overhead and waved to right or left. It has been reported that English war vessels have communicated successfully in this way in Chinese waters, when more than fifty miles apart.

Electric firing circuits for firing the guns and torpedoes of war vessels will undoubtedly be used in the future; these circuits are so arranged that indicators at each gun and in the conning tower show when the gun is laid and ready for firing. The act of firing can then be performed by the pressing of a button in the hands of the gun captain or of the commanding officer, as may be desired. Such an arrangement will be appreciated for broadside or combination firing at close quarters.

The French Navy has recently adopted an electric log, the

each other and from the side of the compass box or binnacle. The coil is placed a few yards from the compass and is supplied by an alternating current of from two to three amperes. The induced current of the secondary coil reaches the pivot of the compass, through a flexible wire, and passes thence to the aluminum capsule that carries the sapphire, and follows along an aluminum wire or pointer which forms a radius of the north pole of the compass. As the ship deviates to the right or left of her course, the current leaps (through a distance of about an inch) from the pointer to the right or left hand insulated plate in the binnacle, and thence flows through one of two electro magnets, which, in turn, close the circuit, in one direction of rotation or the other, of a small 150-watt motor. The shaft of this motor is keyed to the shaft of the rudder motor, which moves the rudder in the direction required to bring the ship back to her course. It is reported that the compass card is entirely uninjured by the current or spark, and that the device has been tested in squadron practice for two months with complete success.

Rapid communication, or exchange of orders, between distant parts of a large vessel is quite a problem. Verbal commands will not carry and the person to be communicated with is usually out of sight. Electric gongs and bells are useful as calls, and speaking tubes are largely used. On the "New York" there is a speaking tube "exchange" below the protective deck and under the conning tower. A far better system would be to have a direct

telephonic connection between the conning tower and such other points as are desired, without any "exchange" at all. Such systems are now installed in many large office buildings and industrial establishments and give great satisfaction. Telephones have been tested aboard ship and found to be entirely reliable and an order can be given clearly by telephone that could not be understood at all through a speaking tube, especially when there is much noise or confusion at either or both ends of the line.

Electric engine revolution counters and direction indicators, thermostatic coal bunker indicators, and helm indicators have recently been successfully developed. They are simple in construction and easy to operate. Some of these appliances, devised by Lieutenant Fiske, are now being installed on the "New York."

Storage batteries have the advantages for ship use that there is no moving machinery about them, they need not necessarily be placed in the dynamo room, they can be charged at any time during periods of light load, and when the heavy load comes on they can be used to help out the plant. They will probably find a proper field of usefulness aboard ship in the future.

The development of alternating current apparatus suitable for the simultaneous operation of incandescent lights, arc lights and induction motors, has emphasized the advantages of this type of apparatus and has greatly extended its sphere of usefulness on shore. The alternating current induction motor has all the advantages of the direct current motor with the great additional feature of having no commutator or brushes. It has become very popular during the last year and if the use of motors aboard ship continues to grow, it is quite possible that future ship plants will be installed on the alternating current system.

Considerable attention has been attracted in England to the possible use of steam turbines, directly coupled to dynamos. Their great compactness and simplicity of construction makes them particularly suitable for marine plants, while their comparatively high speed permits the use of a very cheap dynamo; for in dynamo construction the cost of manufacture varies almost inversely as the speed. Several shore plants using the direct connected steam turbine have been installed in England, and the reports thus far are very favorable. If they prove reliable in service, some sacrifice of steam efficiency can well be afforded with their introduction aboard ship, on account of their many compensating advantages.

The proper operation and care of electric machinery do not call for great technical knowledge, but they do demand the entire time and attention of a few thoroughly trained, practical men. Our seamen gunners in the navy are now trained for this work by an excellent course of practical instruction at the Naval Torpedo Station at Newport, and that these men have the right kind of training is shown by the fact that several of them have left the service to accept offers of more lucrative and important private positions on shore. Men for the merchant marine should have a similar training, and good men can be selected from those who have had practice in operating shore plants.

SOCIETY AND CLUB NOTES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

At the meeting of Council held at 26 Cortlandt street, November 21st, the following associate members were elected: Appleton, Joseph, Electrical Engineer, The Electric Storage Battery Co.; residence, 706 South Washington Square, Philadelphia, Pa. Archer, Geo. F., Student in Electrical Engineering, Columbia College; residence, Garden City, L. I. Ashley, Frank M., Master Mechanic, Ashley Engineering Works, Hawthorne, N. J., 186 Liberty street, N. Y. Blizzard, Charles, General Sales Agent, Electric Storage Battery Co., 45 Broadway; residence, 78 Madison avenue, N. Y. City. Davenport, C. G., Expert and Agent, General Electric Co., 44 Broad street, N. Y. City; Hadaway, W. S., Jr., Electrician, Central Electric Heating Co., 26 Cortlandt street, N. Y. City; Hedenberg, Wm. L., Draughtsman, W. R. Fleming & Co.; residence, 83 Clinton Place, N. Y. City. Munns, Chas. K., Electrician, Strowger Autom. Tel. Exchange, Chicago, Ill.; residence, 1002 W. Monroe street, Chicago, Ill. Ridley, A. E. Brooke, Agent, Electrical Engineer, Siemens and Halske Electric Co., 508 California street, San Francisco, Cal.; Robinson, Francis G., Foreman, Bushwick and Union Avenue Depots, Brooklyn Heights R. R. Co.; residence, 156 Macon street, Brooklyn, N. Y. Varney, Wm. Wesley, Attorney at Law, Electrical Expert, 118 East Lexington street; residence, 1001 Harlem avenue, Baltimore, Md.

The following associate members were transferred to full membership: Sands, H. S., Consulting and Contracting Electrical Engineer, Wheeling, W. Va.; Ross, Norman N., District Engineer, Canadian General Electric Co., Winnipeg, Man.; Cheney, W. C., Superintendent and Electrical Engineer, General Electric Co. Portland, Or.; Bowman, Fred. A., Superintendent New Glasgow Electric Co., New Glasgow, N. S.; Tischendoerfer, F. W., Electrical Engineer, Schückert & Co., Nuremberg, Germany.

At the Institute meeting held at 12 West 81st St. in the evening,

President Houston in the chair, a paper was presented by Professor Geo. D. Shepardson of the University of Minnesota, entitled, "Suggestions for an Index of Engineering Literature." In the absence of the author, Mr. T. C. Martin read the paper and opened the discussion, which was participated in by Messrs. Crocker, Caldwell, the President and the Secretary. Written discussions were also communicated by Messrs. Carl Hering, J. Stafford Brown, M. Osterberg and Professor Goldsborough. Professor H. J. Ryan also sent in a communication upon the subject of "Reactance" in discussion of the paper read at the Philadelphia meeting.

The same papers were also presented before the Institute meeting in Chicago, where the discussion on the Shepardson paper was opened by Mr. Fred De Land.

ANNUAL MEETING OF THE TELEGRAPHERS' MUTUAL BENEFIT ASSOCIATION.

The 28th annual meeting of the Telegraphers' Mutual Benefit Association was held at 195 Broadway, President Merrihew in the chair, on Nov. 21. Immediately after his address, Mr. James D. Reid the Association's first President was invited to the chair amidst hearty applause. In introducing Mr. Reid, President Merrihew paid him a handsome compliment as holder of certificate No. 1, to which Mr. Reid replied most happily. The report of the officers for the 11 months ended Sept. 30th shows that 273 applications were received during the year of which 253 were accepted, 5 rejected, and 15 are pending. The loss by lapse was heavy, due apparently to the hard times which telegraphy in common with all other professions suffered during the year. A net gain of 75 members, however, is shown. The reserve fund was not increased during the year. As explained by the President, all of the interest from the reserve fund was used in payment of mortuary claims, that the burden might be as light as possible on the members. It was however suggested in the President's report that all the mortuary claims should in future be met from the income from assessments, and that the interest from the fund should be returned to the fund annually.

The officers elected for 1895 are the following: President, James Merrihew; First Vice-President, W. H. Young; Second Vice-President, E. J. Nally; Secretary, Thomas E. Fleming; Treasurer, G. W. E. Atkins; Executive Committee: James Merrihew, New York; G. W. E. Atkins, New York; E. B. Pillsbury, Boston; Thomas E. Fleming, New York; E. J. Nally, Chicago; B. Brooks, Denver; W. H. Young, Washington; Joseph L. Edwards, New York; C. W. Hammond, St. Louis; W. C. Humstone, New York; Chas. P. Bruch, New York. Auditing Committee, S. S. Garwood, (Chairman,) Philadelphia; W. J. Dealy, New York; M. J. O'Leary, New York.

In the evening the Magnetic Club had its regular dinner, which was largely attended by representative telegraphers.

NATIONAL ELECTRIC LIGHT ASSOCIATION.

Secretary George F. Porter advises that the eighteenth convention of the N. E. L. A. will be held on February 19, 20, 21 in Cleveland. The headquarters will be at the Hollenden Hotel, and the meetings will be held in Army & Navy Hall.

PERSONAL.

MR. ADDISON G. WATERHOUSE, the well-known inventor of the Waterhouse arc lamp and arc system, who has recently returned from Europe, is now connected with the Mather Electric Company, at their works at Manchester, Conn.

EDUCATIONAL.

ELECTRICAL COURSE AT THE NEW YORK Y. M. C. A.

The course in Electrical Engineering at the New York Y. M. C. A. (23d St. Branch) in charge of Mr. Max Osterberg, E. E., was opened on Nov. 8. There are now 32 students enrolled who receive one lecture a week. The library of the Association contains nearly all the current electrical books, which, of course, are at the disposal of the students. The course will comprise 25 lectures covering the whole range of applied electricity.

FREE LECTURES TO THE PEOPLE IN NEW YORK.

THE admirable series of free lectures to the people provided by the New York Board of Education under the superintendence of Dr. Henry M. Leipziger will be continued this winter, beginning Jan. 10, 1895.

These lectures are devoted to subjects on art, literature and

science, and among those of a technical descriptive character we notice "The Electric Light," by Mr. Max Osterberg; "Machinery, Electricity and Manufactures at the World's Fair," by Mr. G. H. Payson; and "The Trolley," by Mr. F. N. Pedersen.

LITERATURE.

Three Boys On An Electrical Boat. By John Trowbridge. Boston; Houghton, Mifflin & Co. 1894. Cloth. 215 pp. Price \$1.

This is an excellent little story for boys, briskly told, of adventures in the field of electrical navigation, beginning with an electrical ice boat and closing with an electric submarine torpedo craft. There is a convincing air of plausibility and feasibility about the technical features of the story, and the youngsters who read it will unconsciously absorb a good deal of interesting information about the newest department of applied electricity. It is a pity there were not a few cuts in the book.

The Life And Inventions of Thomas Alva Edison. By W. K. L. and Antonia Dickson. New York. Thomas Y. Crowell & Co. 1894. Cloth. Quarto. Illus. 862 pp. Price \$4.50.

The story of the career of Mr. Edison is tolerably familiar in these days, when the great inventor is "written up" about fifty-two times a year on the average; and yet one can hear such an interesting record a good many times without growing weary. In the present instance the narrative is more copious and dignified than upon any former occasion, and its dress is very handsome and attractive. The authors being in confidential relations with Mr. Edison have naturally had access to material that would be difficult for others to get at, and on the whole they have used discretion. Some things were better left out; others might preferably have been included, but the book as it stands is most interesting and instructive, and should find a host of readers. The technical side of Mr. Edison's great achievements is lightly touched upon, far too lightly to make the book of permanent value in the history of the electrical arts; and one would willingly exchange a little of the superabundant obsolete lore from fusty mythology for the sake of more definite descriptions of some of the apparatus. But the book is avowedly written for the magazine rather than the technical public, and as a popular life hits pretty near the mark. It contains plenty of brisk, stirring episodes; and the story is unfolded very prettily and gracefully, carrying the sympathetic reader along with pleasurable emotions from stage to stage of invention and success. Through it all one feels the genuine bigness of the hero; his hearty love of work; his indifference to discouragement; his swift perception of new paths to new goals; his courage in the midst of difficulties; his everlasting American grit and determination to get there, if a "there" exists, or can be created. Attempting to tell such a story, the biographers are apt to become slightly intoxicated by their own enthusiasm, but we forgive them in this instance, and thank them for an inspiring volume devoted to high endeavor and brilliant inventive triumph. As a piece of publishing, the book is most meritorious, paper, cover and text being admirable, while the cuts and the photographs used are remarkably fine.

"THE ELECTRICIAN." Electrical Trades Directory & Handbook for 1895, is now going through the press, and we request on behalf of the editors that all in this country to whom requests for information have been made will be prompt in returning the data blanks properly filled up, to London, in order that this excellent publication may be fuller and better than ever.

SHADING LIGHTS NOT PAID FOR.

In reference to the resolution passed by the Harrisburg, Pa., city council regarding arc lights to be shaded from suburbs that would not be consolidated, Mr. C. H. Kinter, general manager of the Harrisburg Electric Co., writes us that at the next meeting subsequent to the passage of the resolution, its author stated that he had introduced it in a spirit of buncombe and fun. The resolution was therefore repealed, and the order has not been carried out.

A somewhat analogous case occurred once in the State of New York, when the authorities of a certain village refused to pay for more than half of the light of a certain lamp, on the ground that the other half shone in an adjoining bailiwick. They ordered the removal of the pole so that the light could not cross the line. But a public spirited citizen whose place received the benefit of the light across the border, agreed to pay for the beams that shot across; and for several years therefore the bill went in to the village authorities for only half a light at that particular point. Some people may consider this as smart; but others might regard it as a piece of meanness and want of neighborly spirit.

POWER LOST IN INDICATING INSTRUMENTS AND SWITCHES.

At the late street railway convention at Atlanta the Weston Electrical Instrument Co. distributed a neat brochure, drawing attention particularly to the power losses met with in indicating instruments. In order to bring the point out in a forcible way an actual case is taken, which we consider so good an object lesson that we reproduce it below. The station possessed the following indicating instruments and auxiliary apparatus.

Ampere meters:

1	2,000-amp., showing a drop at full load between terminals of	205 watts.
2	1,000 " " " " " "	94 " "
1	600 " " " " " "	96 " "
2	600 " " " " " "	149 " "
1	500 " " " " " "	53 " "
3	200 " " " " " "	51 " "
8	160 " " " " " "	115 " "
4	150 " " " " " "	88 " "

Total

For 20 hours daily run 15,620 watt hours.

For 365 days 5,701,305 "

The other items to be taken into account are:

8	160 amp fuses, showing a drop at full load of	381 watts.
9	500 " " " " " "	2,053 " "
17	160 " switches, " " " "	334 " "
20	ft. 3,000-ampere conductor, 1 sq. in. cross section	1,620 " "
10	" 650 " " " " " 0.5 "	76 " "

Total

For 20 hours daily run 90,080 watt hours.

For 365 days 32,979,200 "

Add 5,701,305 "

Total 38,580,505 "

Supposing the old instruments to be replaced by copper conductors 1 square inch cross section per 1,000 amperes, these conductors to be utilized as shunts for the Weston ammeters would give a

Loss at full load of	86 watts.
23 Weston shunt ammeters	0.0463 " "
Fuses replaced by circuit breakers, 50 per cent.	1,257 " "
Switches replaced by new ones, 50 per cent.	167 " "
20 ft. 3,500-ampere conductor, 2.5 sq. in. cross section	832 " "

Total

For 20 hours daily run 55,440.9 watt hours.

For 365 days 20,600,937 "

Old style Weston 38,580,505 watt hours.

20 600 937

A saving of 17,979,568 " per year.

At 4.4 cents per kilowatt hour \$ 791.10

Representing interest at 7 per cent. on a capital of 11,301.43

For the instruments only:

Old instruments 781 watts = 5,701,305 watt hours per year.

Weston instruments with copper conductors as shunts 86.05 " = 630,187 " "

A saving of 5,071,168 " "

At 4.4 cents per kilowatt hour \$ 223.13

Representing interest at 7 per cent. on a capital of 2,185.71

It has been found by repeated tests that the usual ammeters have a drop of at least .03 volt between terminals, not counting the drop over the joints, which amounts very often to ten times as much. Such instruments need, on an average, 5 feet of in-leading and 5 feet of out-leading conductor. If we calculate this conductor on the basis of one circular inch per 1,000 amperes, the 10 feet of conductor will have a drop of 0.115 volt. Therefore, one such ammeter, together with the necessary 10 feet of conductor, has a drop of 0.135 volt. In one special case there were needed

18	400-ampere instruments with 10-foot conductor .	973 watts.
4	150 " " " " " "	81 " "
8	200 " " " " " "	216 " "
2	600 " " " " " "	162 " "

Total

For 20 hours daily run 1,481 watt hours.

The power house referred to has a run of 7,300 hours per year, and the total loss in the 32 instruments would therefore reach the serious total of no less than 10,446,300 watt hours per annum. On the basis of 4.4 cents per kilowatt hour, the loss is \$459.64, representing a 7 per cent. interest on a capital of \$6,566.30.

Now, a Weston ammeter of any capacity, if the bus bars are utilized as shunts, operates with a drop of but 0.03 volt, and takes a current 0.07 ampere, which gives for 32 Weston ammeters a loss, all told, of 0.0672 watt. For a run of 7,300 hours per year, that means 490.56 watt hours. At 4.4 cents per kilowatt hour, the loss per year would be two cents. At 7 per cent. interest, that means a capital of twenty-nine cents.

NEW YORK BOARD OF ELECTRICAL CONTROL.

Mayor Gilroy has appointed as members of the New York Board of Electrical Control, Messrs. Jacob Hess, Amos J. Cummings and Henry S. Kearney. Mr. Hess has already been on the Board, and Mr. Kearney has been its engineer. One of the first actions of the new Board has been to grant a permit to the Block Light & Power Co. No. 1.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS
ISSUED NOVEMBER 13, 1894.

Accumulators:—

Method of and Apparatus for Circulating Liquid Electrolytes, F. Schoop, Zurich, Switzerland, 529,190. Filed Dec. 29, 1893.
Method consists in causing a portion of the upper layer of liquid to be propelled at intervals laterally out of the vessel and reintroducing such portion of the liquid into the vessel at the bottom.

Alarms and Signals:—

Signal-Replacer, W. R. Sykes, Jr. and J. P. O'Donnell, London, Eng., 528,907. Filed Nov. 27, 1893.
Automatic Fire Alarm System, H. S. Tunnard, Rugby, and A. M. Keays, London, Eng., 529,000. Filed Feb. 8, 1894.
A discriminating thermostatic fire alarm system for buildings.
Electrical Apparatus for Controlling Signals, S. S. Bogart, Schraalenburg, N. J. and M. B. Leonard, Richmond, Va., 529,059. Filed Dec. 11, 1893.
An automatic electric semaphore block system for steam railways.
Automatic Set-Back Annunciator, H. C. Thomson & G. J. Galbraith, Boston, Mass., 529,144. Filed July 2, 1894.
Trans-Operated Signaling System, J. H. Frischen, Berlin, Germany, 529,165. Filed Nov. 28, 1893.
An electric block signal system for steam railways.

Conductors, Conduits, and Insulators:—

Conduit for Electric Conductors, J. Tatham, Philadelphia, Pa., 529,216. Filed March 17, 1894.
Consists of an inner and outer tube of lead and an interposed tube of insulating material.

Distribution:—

Electrical Transformer, F. S. Culver, Eau Claire, Wis., 528,925. Filed Dec. 19, 1893.
Relates to the mechanical construction of transformers composed of L-shaped stampings secured together.
Electrical Transformer, F. Zickermann, Berlin, Germany, 529,152. Filed Dec. 9, 1893.
Employs means for simultaneously increasing or decreasing the number of the turns in series of the coils which form the primary and secondary elements.
Means and Apparatus for Distributing Electricity, H. T. Harrison, London, England, 529,255. Filed Jan. 19, 1894.
A combined system admitting of running with a low tension dynamo for a light load or accumulators on the consumers' lights and switching over onto a high tension alternator when the load begins to increase.

Dynamoes and Motors:—

Electromagnetic Machine, G. J. Scott, Philadelphia, Pa., 529,055. Filed June 12, 1894.
Employs an armature provided with closed ring conductors in the plane of rotation, field magnets, and collectors bearing upon the rings at points displaced from the neutral plane to produce a distorted field, and connected up in a suitable circuit for the flow of current in opposite directions along the rings.
Regulator for Dynamo-Electric Machines, J. Ferrand, Darnetal, France, 529,117. Filed July 2, 1891.
Invention consists in combining with a shunt dynamo a regulator having one or more carbon columns through which the exciting current passes, and the resistance of which is controlled in accordance with the load.
Dynamo-Electric Machine, R. Thury, Geneva, Switzerland, 529,145. Filed Aug. 15, 1894.
Consists of two horizontal fixed rings of U-shaped section each provided with a coil and a circular pole piece.
Alternating-Current Electrodynamo Machine, M. Hutin, Paris and M. Leblanc, Le Raincy, France, 529,272. Filed Aug. 20, 1892.
A method of synchronizing alternating current motors by generating in the armature a couple of forces which varies with the speed of the armature and tends to accelerate the latter should it lag behind synchronism and to retard it should it pass beyond synchronism; the couple being generated by circuits in the path of the magnetic flux between the armature and the field magnet.

Lamps and Apparatuses:—

Electric-Arc Lamp, J. Brockie, London, Eng., 529,240. Filed June 19, 1894.
Employs a rocking lever and an undulating groove in order to give a reciprocating movement to the carbons of a double arc lamp.

Miscellaneous:—

Radiating and Supply System for Thermo-Electric Generators, H. B. Cox, Hartford, Conn., 528,924. Filed Feb. 27, 1894.
Claim 1 follows:—
A thermo-electric generator having a heat controlled pulsating controlling means for the liquid cooling chamber of the generator.
Self-Winding Electric Clock, A. Lungen, New York, N. Y., 529,900. Filed May 18, 1893.
Ore Washer or Concentrator, C. F. Pike, Philadelphia, Pa., 529,978. Filed April 6, 1894.
Ore Washer or Concentrator, C. F. Pike, Philadelphia, Pa., 529,080. Filed April 6, 1894.
Binding-Post for Electric Instruments, F. A. Lowe, New York, N. Y., 529,127. Filed Feb. 9, 1894.
Claim 1 follows:—
In a binding post, a spring wire helix surrounding and larger than the stem of the post and adapted to receive a connecting wire passed through between its convolutions and around the post.
Apparatus for Extracting Gold, J. B. Hannay, Loch Long, Scotland, 529,263. Filed Nov. 15, 1893.
Stopping Apparatus for Engines, N. E. Nash, Westerly, R. I., 529,297. Filed April 25, 1894.
Electric Gas-lighter, C. G. Savage, Philadelphia, Pa., 529,313. Filed June 12, 1894.
Electromagnet, C. C. Gerlach, Cleveland, Ohio, 529,325. Filed Dec. 9, 1893.
Employs a series of coils partially wound with flexible non-conducting material so as to present alternately the covered and bare wire and to admit an insulating medium between the strands.

Railways and Appliances:—

Intersecting Electrical Railway Tracks, M. Lowd, Salem, Mass., 528,959. Filed Feb. 10, 1894.
Employs an intersecting rail having a tread of insulating material and base of metal.
Underground Conduit for Electrical Roads, E. A. Mathers, Romeoville, Ill., 528,968. Filed June 12, 1894.

Relates especially to means for closing an inner conduit containing the conductor except during the passage of the car and also for the insulation of and the exclusion of moisture from the trolley wire.
Trolley-Wire Hanger, J. M. Anderson, Boston, Mass., 529,058. Filed July 19, 1894.

Employs a coiled spring within a casing by which the hanger is flexibly supported.

Switches and Cut-Outs:—

Automatic Electric Cut-out, D. F. Sweet, Grand Rapids, Mich., 529,212. Filed April 28, 1891.
Employs a swinging bar carrying one of the contact plates and held in a closed position by a latch controlled by an electro-magnet.
Electrical Cut-out, D. F. Sweet, Grand Rapids, Mich., 529,313. Filed June 9, 1894.
A cut-out adapted to be readily set to respond to any predetermined strength of current.

Telegraph:—

Autographic Telegraph, J. O'Neill, New York, N. Y., 529,300. Filed Nov. 27, 1893.
The message to be transmitted is written in non-conducting ink upon a conducting transmitting sheet in such manner that the interruption of the current through the sheet by the non-conducting characters thereon may produce corresponding characters upon a receiving sheet at the other end of the line.

Telephones and Apparatus:—

Magnetic Telephone, O. Higgins, Napoleon, Ohio, 529,174. Filed July 16, 1894.
An instrument combining the receiver and transmitter in a single case so formed that when the transmitter is at the mouth the receiver will be at the ear.
Telephone, J. Serdinko, San Antonio, Texas, 529,308. Filed April 28, 1894.
Claim 1 follows:—
In a telephonic instrument, the combination with the magnets of the magneto-call, the bobbin, and the diaphragm fixed in the front of the latter, of an iron disk fixed in proximity to the said magnets, and a core fixed to said disk and extending through the bobbin into close proximity to the diaphragm.

LEGAL NOTES.

EDISON ELECTRIC LIGHT CO. vs. SUNBEAM LAMP CO.

Simultaneously with the Davis Company's application in Boston a week ago the Sunbeam Company at Chicago applied to the U. S. Circuit Court for a dissolution of the injunction against them because of the expiration of the Edison lamp patent November 17 under section 4887 U. S. Revised Statutes. Judge Seaman concluded to continue the motion pending a decision of the Bate case in the Supreme Court at Washington.

WHY NOT USE DECENT BRAKES?

A dispatch from Pittsburgh of Nov. 21, says: At 11 o'clock this morning an electric car of the Centre avenue branch of the Central Traction Company became unmanageable on a heavy Wylie avenue grade and dashed into a Wylie avenue cable car, just astern with terrific force. Three lady passengers were injured, one seriously. The motorman of the electric car, who stood at his post, was also seriously injured. The electric car was a complete wreck. The brakes did not work. We also note serious accidents in Omaha and Jersey City, due to a like cause.

A MUNICIPAL PLANT FOR LISBON, IA.

The City of Lisbon, Iowa, has closed contracts for a new municipal electric lighting plant. The Fort Wayne Electric Corporation, through their Western agent, Mr. E. T. Pardee, of Omaha, get the contract, including a 750 light "Wood" alternator; and the Buckeye Engine Company, of Salem, O., through their Chicago agent, Mr. H. E. Troutman, get the contract for steam plant, including a 75 H. P. Buckeye engine. Work will be commenced at once.

RECEIVER FOR THE NEPTUNE ELECTRIC CO. OF ASBURY PARK, N. J.

Judge Joseph H. Gaskill has been appointed receiver for the Neptune Electric Company of Asbury Park. The affairs of the company have been in bad shape for some time. Recently an effort was made to induce the creditors to accept 60 per cent. in cash, 30 per cent. in bonds and 10 per cent. in stock. The creditors discussed the matter and applied for the receiver. The appointment wipes out \$64,000 worth of common stock, the greater portion of which is held by Asbury Park business men. The original capital stock is \$200,000, but only \$64,000 was paid in. Last January the plant was leased for two years to Thomas Grimwood, an electrician. The immediate cause of the wreck is said to have been the extension of the lines to outside places. This cost the company about \$70,000. The bonds issued to pay for the work proved unsalable and the company became involved through the creditors pressing for a settlement. The plant is estimated to be worth \$170,000.

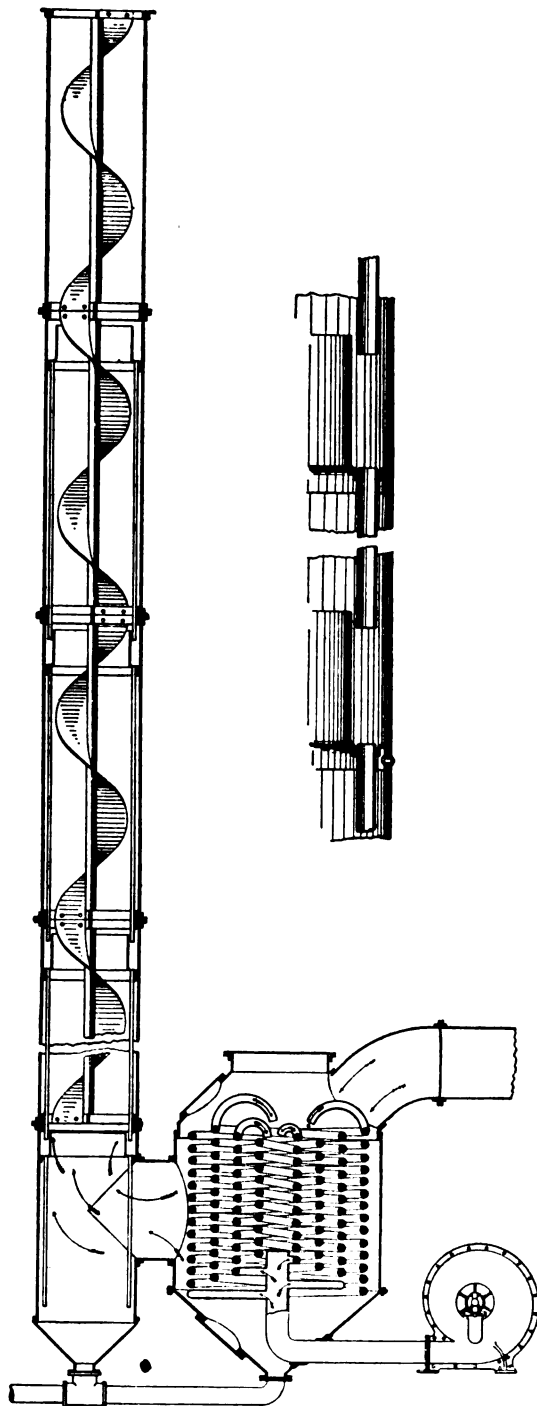
The report of Commissioner of Public Works Daly, of the city of New York, shows that the streets, docks, etc., are lighted by 42,392 gas lamps, 3,621 electric lamps, and 158 naphtha lamps.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE DE RYCKE CONDENSING EXHAUST PIPE.

THE accompanying engraving represents a new condensing exhaust pipe recently patented by Mr. Jos. De Rycke, of No. 145 Broadway, N. Y., and the object of which is to condense the



THE DE RYCKE CONDENSING EXHAUST PIPE.

exhaust steam from an engine, so that the water of condensation may be returned to the boiler as feed, or be used in any other way desirable. It may also be applied to any pipe where condensation of the steam is required. The exhaust steam entering at the right, as indicated by the arrow, is distributed throughout the air pipe chamber, and passes out into the exhaust pipe, which may or may not be surmounted by an exhaust head. Cold air from a pressure blower is forced through the air distributing pipes in the pipe chamber to assist in the condensation. The vertical part of the exhaust pipe is made in sections, flanged at the ends for bolting

together, and for bolting the exhaust head at the top. In these sections are stationary spiral plates, supported by a central shaft or arbor, and kept from turning by being riveted or bolted to cross-bars, which are secured to each section of the pipe. These spiral plates give a centrifugal motion to the steam, by which the water particles are thrown outward against the sides of the pipe. Annular troughs are placed along the interior to catch the water as it descends. Pipes are provided for taking the water from one trough to another, as shown in the enlarged view, the water being carried to the lower trough and drained off through the small pipe at the bottom.

The coiled air pipes may be perforated if desirable. The upper ends of these pipes are curved, so as to give a downward discharge of the air into the pipe chamber. By regulating the speed of the blower, any amount of cold air may be discharged into the exhaust pipe, so that any degree of condensation may be secured. The diameter of the exhaust pipe is made equal to the combined area of the main from the engines and the blower pipe.

This exhaust pipe is specially designed for large power stations, but the base and blower can be applied to existing exhaust pipes where it is desired to reduce the escape of the exhaust steam to a minimum. Where the condensed steam is to be used as feed water, grease extractors are applied to the engines.

THE FALKENAU ENGINEERING CO., PHILADELPHIA.

THE FALKENAU ENGINEERING CO., LIMITED, are now actively engaged in installing a 1600 light plant at the Bartram Apartment House, 83rd and Chestnut Sts., Philadelphia. This plant will be completed to and including lamps. The boilers are water tube boilers, made by John L. Gill, Philadelphia, feeding two 75 H. P. Woodbury engines, direct coupled to two 45 kw. Mather generators. The switchboard has been specially designed for this plant, and made in the shops of A. Falkenau, president of the company. The contract for this plant also includes a complete telephone system for seventy-three apartments, and an automatic fire alarm. The telephones are of the Colvin system, and are being installed by Messrs. Harry S. Smith & Co., of Philadelphia, subcontractors. The plant, when finished, will be one of the finest private electric plants in Philadelphia.

This firm have also just completed an underground electric service for the suburb of Llanerch, Pa., and have wired all of the houses, power station, etc., of the same place for electric lighting.

They have also been awarded the contract, recently, for the lighting of the new Student's Hall, University of Pennsylvania, and also the contract for the Diocesan House, at 12th and Walnut Sts., now being erected by the Episcopacy of the city. This will be a twelve story building, arranged for use as an Episcopal Headquarters, with stores on the ground floor.

A special storage battery switch board, designed by this company, is also being erected now at the Drexel Institute, Philadelphia, for experimental use. This board will handle fifty-two batteries, charging them either in series, or two sets in parallel, and provides for their discharge in any desired combination, through one or more of twelve different discharge series at the same time.

The company is also building the large storage battery board for installation in the New York station of the Edison Illuminating Co. This board was designed by Mr. J. Appleton, of the Electric Storage Battery Co., and is over twenty feet long by eleven feet high. All the special switches and cut-out devices are being made specially for this board.

The company has also just completed some work at the University of Pennsylvania, and has a large number of contracts pending, among others, a municipal plant for a large southern city, for which plans have already been submitted and are now undergoing examination.

ELMER G. WILLYOUNG & CO.

MR. ELMER G. WILLYOUNG has just returned to Philadelphia after a two months visit to England, where he has consummated arrangements for acting as the sole American agent for Messrs. Nalder Bros. & Co., London, the largest manufacturers of electrical instruments of precision in the world. He will also act as the agent for James White, Glasgow, Scotland, maker of Lord Kelvin's balances and electrostatic measuring instruments, and for L. Oertling, London, analytical and assay balances.

Mr. Willyoung, who was for six years, the electrical expert of Queen & Co., is generally recognized as the first to seriously take up in America, the manufacture of electrical instruments of precision, and is the author of many improvements and refinements in electrical measuring instruments.

Arrangements have also been made, with other foreign firms, to import apparatus at most advantageous rates, and to have any instruments which may be damaged in transit, repaired by experienced workmen, under the personal supervision of Mr. Willyoung.

It is the intention of Nalder Bros. & Co., and James White, to

make as rapidly as possible, such modifications in the design of their instruments, as shall better adapt them to the needs of American users, and new instruments, especially fitted for American practice, will be designed, and brought out as rapidly as possible.

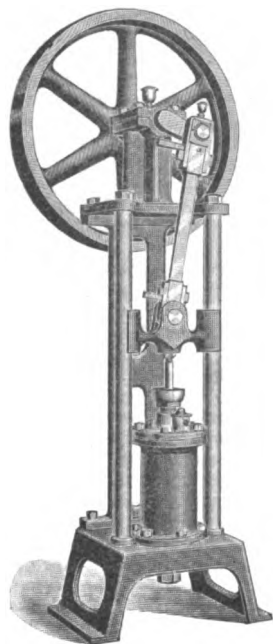
Mr. Clayton W. Pike, formerly of Queen & Co., will be associated with Mr. Willyoung. Mr. Pike was in charge of all the World's Fair exhibits of Queen & Co., and has a very extensive acquaintance among the colleges and technical schools, having personally visited nearly all of them, during the year previous to the World's Fair, for the purpose of obtaining a better acquaintance with their requirements.

The offices of the new firm are at 1210 Betz Building, Philadelphia.

THE NEW PACKARD VACUUM PUMP.

We illustrate in the accompanying engraving a new model of the Packard vacuum pump, so well-known to incandescent lamp makers. These pumps are universally used in incandescent lamp factories for the production of the preliminary vacuum in the lamps before the mercurial pump is set to work, for the operation of the mercurial pump and for producing a vacuum in the flashing bottles where the lamp filaments are subjected to the operation of "flashing" or "treating."

These pumps have not heretofore been made with a single cylinder, as they were designed primarily for use in factories where a number of them were required and were therefore, for



NEW PACKARD VACUUM PUMP.

the sake of compactness and economy of operation, made with two or three cylinders combined in each pump. To meet the demand for the high grade vacuum pump for use in laboratories and experimental work in lamp factories the single cylinder design illustrated is now put on the market. For simplicity and compactness this is built with a single cylinder of large diameter and ample length. The frame, as will be seen, is open, making all parts perfectly accessible and perfectly rigid. The valve arrangement which has lately been improved and strengthened is precisely the same as in the larger sizes of Packard pumps and the pump is in every way adapted to heavy continuous work. A vacuum within one half-inch of the barometric pressure is readily obtained. The pump illustrated has a cylinder $4\frac{1}{2}$ " in diameter by 8" stroke.

The Packard vacuum pumps are manufactured under the patents of J. W. Packard by Norman Hubbard of 93 Pearl St., Brooklyn, N. Y. There are at the present time over two hundred Packard pumps in use among lamp makers.

THE NEW WESTINGHOUSE WORKS.

The new works of the Westinghouse Electric and Manufacturing Company at Brinton, near Pittsburgh, are now being fitted with machinery, and the business of manufacturing the company's product will be commenced immediately. The company has at present unfilled orders exceeding \$1,500,000, which with the current orders will give full employment to the new works. In view of the concentration of all of the manufacturing depart-

ments in one plant the following changes in the officers of the Company have been made to meet the new conditions. Mr. W. F. Zimmerman, formerly Assistant General Manager, has been made General Eastern Agent, with office at 120 Broadway, New York. Mr. W. C. Clark, formerly Assistant Treasurer and General Agent has been made Assistant General Manager with office at Pittsburgh. Mr. George H. Lewars, formerly Treasurer of the Consolidated Electric Light Company has been elected Assistant Treasurer with office at Pittsburgh, to take effect December 1st.

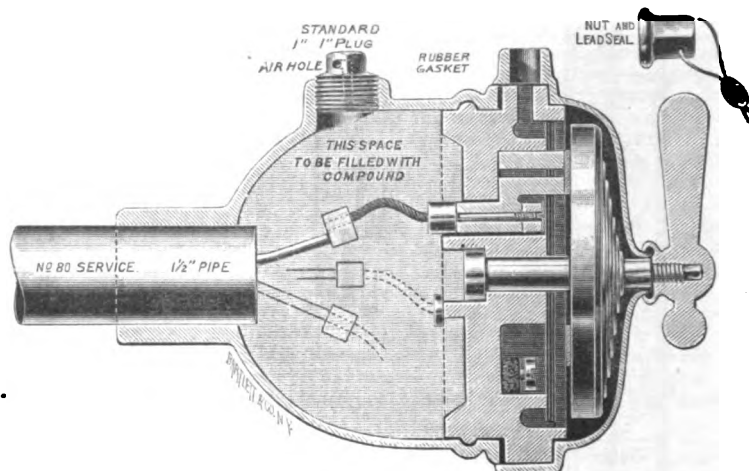
Mr. Albert Schmid, formerly Superintendent, has been made General Superintendent and Mr. Philip Lange, formerly Assistant Superintendent in charge of the Newark Factory, has been made Superintendent of the Brinton Works.

GOULDS MANUFACTURING COMPANY.

The Goulds Manufacturing Co., of Seneca Falls, N. Y., and 16 Murray street, New York city, have issued a special addendum to their 1893-94 catalogue, comprising some recent additions to their manufacture of pumps and hydraulic machinery. This includes pumps for all kinds of wells, and force pumps for mines, etc., for manual or machine power. A general catalogue, containing descriptions of the new triplex power pumps, is now in press and will be issued about the first of January.

VAN VLECK SERVICE END CUTOUT.

We illustrate in the accompanying engraving the improved service end cutout of the Interior Conduit and Insulation Co. which is being generally called for in architects' specifications as well as required by underwriter associations. It is placed at the inlet of the three-wire system to buildings and is the point at which all the circuits for light and power are controlled. In case of fire



VAN VLECK SERVICE END CUTOUT.

the cutout is accessible to firemen. Its advantages over a triple breakdown switch are apparent, as it is thoroughly waterproof. The switch is almost always placed in a location where there is more or less dampness.

The application and method of installing the cutout are so clearly shown in the engraving as to require no further explanation. The piece of pipe enclosing the three conductors embedded in insulating material, is a standard article of manufacture, as are the flexible conductors used within the iron case.

The service end cutout was devised by Mr. John Van Vleck, electrician of the Edison Illuminating Co., New York, who made use of the Johnson vise lock switch as a part of the combination.

DICK & CHURCH ENGINES.

Owing to the assignment of the Altoona Mfg Co., Mr. Edward F. Austin, their former sales agent, who met with such success in the Pittsburgh District, has taken charge of the Pittsburgh office of the Phoenix Iron Works Co., of Meadville, Pa., manufacturers of the well known "Dick & Church" engines, boilers, feed water heaters &c. Mr. Austin reports the sale of a 15x18 engine to Jones & Laughlin; and three 100 H. P. boilers for the Schenley Park Casino. These boilers are particularly designed for safety, &c. and are of special make all through. He also reports several smaller orders and states that inquiry is increasing from all localities and that he looks forward to an increase of trade in the boiler and engine business.

ELECTRIC RAILWAY WORK OF THE ALLGEMEINE ELEKTRICITAETS GESELLSCHAFT.

Among European countries, Germany by far outstrips its neighbors in the number of electric railways, both in operation and in course of construction. Although this work was partially neglected until within three or four years ago, we note a most healthy activity in this field and a recognition of the benefits of electric railroading which will eventually lead to its general adoption in the same way that electricity has supplanted the horse on our own street railways. It is also worthy of note that one of the most prominent street railway associations in Europe, the Internationale Permanente Strassenbahn Verein, at its convention, held in Budapest last year, adopted a resolution endorsing the electric railroad and recommending its adoption wherever circumstances would allow its use.

An excellent idea of the manner in which electric railway plants and apparatus are being installed in Germany is afforded by the electric railway catalogue just issued by the Allgemeine Elektricitäts Gesellschaft, of Berlin. It contains a description of the company's apparatus, including both motor and overhead construction, and, in addition to this, a detailed description of a dozen roads, equipped by this company, with engravings reproduced from photographs, showing the prominent points of the roads, plans and details of power houses, profile of the track, etc. The methods adopted are very close adaptations of American practice in all departments. We note the exclusive use of the single reduction gear on the motors, while the overhead line material, such as line insulators, pull-offs, trolley switches, etc., are, naturally, patterned after our own devices of this nature. Wherever it is possible in narrow streets, the pole construction is avoided, the span wires being attached to the walls of houses, by means of neat rosettes. In every case the line work is carried out as neatly and in as unobtrusive a manner as possible. Indeed, we note one instance where a public place in Breslau is provided with a span wire having a length of probably 250 feet, in order to avoid marring the beauty of the surroundings by poles. Would that this practice were followed more frequently here.

The largest installation equipped by the Allgemeine Elektricitäts Gesellschaft is that at Breslau, which has 40 motor cars and 40 trailers; and the dozen roads now in operation equipped by that company aggregate 90 miles of track, with 239 motor cars and 153 trailers, while those in course of construction aggregate 31 miles of track, with 101 motor cars. We are also informed that other roads in Germany that contemplate installing electricity aggregate 96 miles of track. We note that in Gera, the railway power station also supplies current for light and power, and in Königsberg i. Pr., the railway power station is combined with the municipal electric light works. Besides the roads in Germany, the company has also equipped a road at Kieff, in Russia, with 26 motor cars, a feature of which is the employment of gas motors for driving the generators. It is proposed eventually to employ steam and to have the gas engines as a reserve. One of the gradients on this road, described in page 436, amounts to no less than 1 in 9.5.

TRIUMPH ELECTRIC COMPANY.

The Triumph Electric Company, of Cincinnati, makers of electric light and power machinery have closed some twelve contracts during the past fortnight, including a duplicate order from Sioux Falls, S. D. Mr. Hobart reports a rapid opening up of business for the Triumph Co.

ELECTRICAL SUPPLIES FOR THE GOVERNMENT PROVING GROUNDS.

The following awards have been made for furnishing the Sandy Hook Proving Ground, N. J., with electrical supplies:

E. S. Greeley Co., New York, N. Y., 100 cross arm pins, 2 cents each; 86 carbons, Greeley's, 14 cents each; 36 carbon clamps, 6 cents each; 36 carbon connectors, 30 cents each; 50 zincs, \$1.25 each; 50 zinc connectors, 9 cents each; 250 feet double conductor for firing cables, 4 cents; 30 double connectors, plain, 8 cents each; 6 Gaesner dry cells, 7x8 inch diam., 95 cents each; 300 insulators, porcelain, 1½x1½ inch, with screws, 2 cents each; 100 do., 1½x¾ inch, 1½ cents each; 500 do., small spool with screws, No. E2, 1 cent each; 12 glass jars, 6 inches diameter, 8 inches deep, 20 cents each; 175 porous cups for electric batteries, 9 cents each; 23 push buttons, plain, No. 1, 10 cents each; 24 do., metal, 15 cents each; 12 posts, binding No. 2, 9 cents each; 12 do., No. 1, double, 14 cents each; 12 do., No. 2, double, 14 cents each; 4 switches, pole changing, \$1 each; 2 dozen tips, straight, for conducting cords, 15 cents; 50 feet rubber tubing, hard, ¼ inch inside, ⅜ inch outside, 8 cents; 3 lbs. black insulating tape, 70 cents; 1 telegrapher's pocket tool case, containing 36 tools, \$3.75 each; 1,000 lbs. wire, phosphor bronze, No. 7, unannealed, 45 and 47 cents; 200 zincs, 1 inch diameter, 7 inches long, for De Wolski battery, 14 7-10 cents; 25 zincs for LeClanche cells, 7 in. long, ¾ in. diameter, 3½ cents.

International Trading & Electric Co., New York, N. Y., 10 DeWolski's cells, complete for Daniells' battery, \$1.30 each; 200 lbs. galvanized iron wire, No. 7, 8¼ cents.

Western Electric Co., New York, N. Y., 100 insulators, patent screw, glass, regular pattern, 3 cents each; 12 line wire connections, small, 8 cents each.

CONTRACT AWARDED FOR BATTERY SUPPLIES.

The contract for furnishing the following electric battery supplies for the use of Public Buildings and Grounds has been awarded to Royce & Mareau, of Washington, D. C.: Crowfoot zincs, 5x7 inch, 13½ cents each; blue stone, 4 cents per pound; sal ammoniac, 8 cents per pound; K. K. copper line wire No. 13, 15½ cents per pound; galvanized line wire, extra best, No. 12, 5½ cents per pound.

75,000 GERMAN LAMPS.

We hear that 75,000 German incandescent lamps are on the water, bound for New York, the idea being that the market is now open, and that such lamps can undersell the American even with 35 per cent. duty. The consignee's name has not slipped out.

WESTERN NOTES.

The Ohio Supreme Court has affirmed the constitutionality of the law requiring electric cars to be provided with substantial vestibules to protect the motormen from the weather in winter.

THE COOK COUNTY ELECTRIC RAILWAY, LIGHT AND POWER COMPANY has been formed; capital stock, \$500,000; incorporators, Clarence N. Durand, Abner T. Young and Charles Greenwood.

CLINTON, ILL.—The Clinton Telephone Company has been incorporated by Arthur Moore, L. C. Watts, Richard Butler and others.

JOLIET CONSOLIDATION.—Steps are being taken for the consolidation of the Joliet, Ill., Street Railway Co., the Economy Light & Power Co., and the Joliet gas works.

ST. LOUIS, MO.—Street Commissioner Murphy is consulting with G. F. Durant of the Ball Telephone Co. and C. H. Turner, president of the St. Louis & Suburban Railway Co., as to the burial of the wires along the boulevards.

MR. H. B. VAN SICKLE, of Toledo, O., writes us that he is pushing the construction of the Delaware, O., and Centerburg Electric Railway, which will be about 20 miles in length, connecting Eden, Olive Green, Rich Hill, etc., with Centerburg.

THE ELECTRIC APPLIANCE COMPANY are hard at work upon their catalogue of electric railway supplies and hope to have it ready for distribution in a few weeks. They promise to list a very desirable line of electric railway material including the "Lynn" specialties.

THE WESTERN OFFICE of the Bryant Electric Company have issued through the trade a circular describing their latest specialty, "The Chandelier Switch." These switches are kept in stock at their store rooms in the Monadnock Bldg. Messrs. Grier Brothers, western representatives.

THE WILDER-SLOSS ELECTRIC HOTEL CALL CO. has been incorporated at Chicago with a capital stock of \$25,000 by Louis Stein, E. R. Wilder and Aug. Binswanger. The company will manufacture the Wilder Hotel Call, as well as other electrical devices.

SAGINAW, MICH.—The Union Street Ry. Co. has bought the old horse car lines of the city, known as the City of Saginaw Railroad, and will at once equip them electrically. This brings all the street car lines under one management. Detroit parties are at the head of it.

BALL ENGINES.—The City of Morganfield, Ky., are putting in an electric plant, the power to be furnished by an engine built by the Ball Engine Co., Erie, Pa. The Freeport Electric Railway, Freeport, Ill., has purchased a 150 H. P. engine from the Ball Co. The Lebanon Electric Light & Power Co., Lebanon, N. H., are installing a 150 H. P. Cross Compound engine, built by the Ball Co.

METROPOLITAN ELECTRIC CO., No. 186 and 188 Fifth Ave., Chicago, have made arrangements with the patentee to handle the Allen soldering stick, and have a large stock on hand, and will be able to sell to the dealer or consumer at satisfactory prices. This little article is well-known to the trade and occupies its niche in the gallery of specialties of the Metropolitan Company.

THE CENTRAL ELECTRIC COMPANY have contracted for the General Western Agency for the well known line of switches manufactured by the W. S. Hill Company. The Central Electric Company will carry a large and complete line of these goods in their Chicago warerooms. This affords many advantages to customers in territory tributary to Chicago. The saving in freight and express charges will amount to an item of no little importance to buyers. Another article that is receiving considerable attention is the Kinsman desk lamp. Everyone who

has used this admirable desk fixture gives it unqualified approval. The Central Electric Company also controls the sale of these in the West.

MR. M. B. AUSTIN, formerly with the Knapp Electrical Works, is fitting up offices in the Monadnock Block, Chicago, where he will represent the Safety Insulated Wire Co., New York, and Holmes, Booth & Haydens, Waterbury, Conn. Mr. Austin is well known to the electrical trade, and representing two such prominent firms, will have no difficulty in getting his share of the business.

MR. W. H. HORNBERGER, of Elkhart, Ind., has sold his entire interest, patents included, in the Hornberger Elec. Mfg. Co. of that place, to Mr. J. C. Boss. Mr. Hornberger established the enterprise five years ago, and its transformer has become universally known. He is a man of great energy and resource, and is likely to be heard of again in the electrical field, which has plenty of room for men of his stamp.

WESTINGHOUSE ORNAMENTAL LAMP BULBS.

HERETOFORE the only method available for enhancing the beauty of the incandescent lamp has been by the addition of ornamental shades. These involved additional expense and to some extent cut off a portion of the light. In order to meet the demand for ornamentation the Westinghouse Company has just brought out an ornamental stopper lamp, in which the bulb is blown with artistic designs in relief, giving the lamp a highly ornate appearance. The cost of this lamp is not materially greater than that of the plain, and as it obviates the necessity of a shade it ought to become very popular.

NEW YORK NOTES.

BROOKLYN, N. Y.—An attempt is being made to reduce the speed of the trolley cars to six miles an hour, but is hardly likely to be successful.

MR. W. M. MINER has resigned his position as general manager of the American Mfg. & Eng. Co., and will hereafter devote himself to expert electrical work and to the affairs of the Bi-Metallic Electrical Transmission Co., 80 Broadway.

BLOOMER BROS.—Three executions against Bloomer Brothers & Co., electrical contractors at 26 Cortlandt Street, have been received by the Sheriff in favor of the following creditors: Davidson Ventilating Fan Company, \$905; Bryan-Marsh Company, \$701; Stanley & Patterson, \$688.

THE OAKMAN ELECTRICAL CO., 186 Liberty Street, New York, have recently added to their already large list of specialties the Partridge carbons and the Medbury insulation for overhead railway work; besides which they are handling the new Burns trolley base.

NEW YORK GARBAGE.—The Garbage Commission has decided against further dumping in the bay, recommending a more systematic selection of the different classes of refuse, partial reduction, the continued use of Riker's Island (see E. E. Aug. 8, 1894) and the regular disinfection of the streets and the garbage carts.

MR. WM. CRAIG, 107 Liberty street, has issued a circular of his improved vertical direct acting steam pumps, vacuum pumps, condensers, etc.; also a folder with regard to his automatic three way check valve, among the commanders of which is Mr. W. Lee Church who used it at the Newton & Boston Street Railway Co.'s power house.

THE ELECTRIC ENGINEERING AND SUPPLY CO., of Syracuse, N. Y., have opened an office in the Electrical Exchange Building, room 315, with Mr. F. M. Hawkins as special New York agent. They have also opened a store room at 132 Washington street, where they will carry a sufficient line of stock to meet all the wants of their New York customers.

THE CLAYTON AIR COMPRESSOR WORKS, Havemeyer Building, 26 Cortlandt Street, New York, have sent us a copy of their newest publication on the "Uses of Compressed Air." This list cites about seventy different applications of air under pressure, and is a most convincing commentary upon modern advancement in engineering, manufacturing and industrial lines. It is of especial interest to engineers, railroad men, machine and construction shops, granite and marble works, chemical works, sugar refiners, rubber and silk mills, tin ware, pipe and hose manufacturers; to all industries that use artesian wells, automatic sprinklers for fire protection, oil for fuel, and to physicians, hospitals and baths using sprays for curative purposes.

NEW BUNNELL CATALOGUE. We have received the latest edition, No. 14, of the general catalogue of telegraph, telephone, railway, and electric lighting supplies issued by the ever progressive house of J. H. Bunnell & Co., 76 Cortlandt street. It includes also phonographs, graphophones, fans, bells, and all

other devices in which electricity plays a part in even the smallest way. This useful and well arranged catalogue contains 225 pages and nearly 250 illustrations.

NEW ENGLAND NOTES.

THE CAMPBELL ELECTRICAL SUPPLY CO. have recently contracted for the entire tape production of a large cotton factory, and are enabled to offer their well known Century insulating tape at much lower prices than ever before. The tape is put up in half-pound rolls, in widths $\frac{3}{4}$ inch, 1 inch and 2 inches, and will be found to be a substantial, solid, firm, and waterproof article.

THE BOSTON INCANDESCENT LAMP CO., of Boston, have entered the field again with their well known Boston incandescent lamp. They do not use any platinum for leading in wires, but manufacture the Pollard type of lamp, which uses silver powder deposited on the glass, for the inleading conductors. Their price at present is 25 cents for lamps in barrel lots and 26 cents for the anchored filament railway lamp. Besides these, they are making large quantities of series lamps for arc and alternating circuits.

THE MATHER ELECTRIC COMPANY of Manchester, Conn., have just concluded arrangements with Manning, Maxwell & Moore, of New York, and the Niles Tool Works, of Hamilton, Ohio, for a large amount of new machine tools, which will be installed in the Manchester plant at once, and which are especially adapted for the building of large direct connected and belted generators, which the Mather Company are now making quite a specialty of. The plant at Manchester has been running overtime with full force for the last two months, and the company now has orders on hand to keep their entire plant busy from four to five months.

THE ANCHOR ELECTRIC CO., of Boston, are gradually getting their new quarters on Federal street, into something like ship-shape order. They have had so many orders of late and so much shipping to be done, that they have hardly had a chance to get the goods put into their proper places, and one has still to pick a way carefully through the store. They are making every effort, however, to get things tidied up, though it is hinted that already, they are beginning to find their new quarters rather cramped for room. In these dull times it is consoling to hear such encouraging reports of increasing business.

STONE & WEBSTER, of Boston, have issued a neat little pamphlet relating to their testing department, with particular reference to candle power measurements of incandescent lamps. They have, probably, the best equipped laboratory for this purpose in the country, and have perfect photometric apparatus, so that the tests are absolutely accurate. Besides the horizontal candle power test, the one most frequently made on lamps, they are well equipped to make life tests on incandescent lamps, from which the relative merits of various lamps can be compared throughout their life. The results of this test are generally put in the form of a curve, showing graphically how the candle power falls off as the lamp continues to burn, and the increase in the consumption of energy. A long list of all kinds of other tests follows, showing how well equipped they are for making tests on every conceivable piece of electrical apparatus.

PHILADELPHIA NOTES.

MR. J. PAUL GAYLORD, president of the Pennsylvania Electrical Engineering Co., has returned from a two months' trip to Europe in the interests of his company.

THE SCRANTON, PA., ELECTRIC CONSTRUCTION CO. has been formed with a capital stock of \$15,000, to manufacture plants for mine drilling, lighting, hauling, pumping, ventilating, etc. The directors are: W. T. Smith, O. S. Johnson, E. B. Sturges, F. J. Sturges, Scranton; J. C. Platt, Waterford, N. Y.

PARTRICK & CARTER CO., 125 South Second street, Philadelphia, notify the trade that they are now the sole selling agents for the Applegate electric matting, which will hereafter be made in three standard widths, 2, 2½ and 3 feet, while each roll will be 50 feet long. This is a useful and meritorious specialty and could not be in better hands.

THE TRENTON TROLLEY WAGON. We have been requested to state that the Trenton trolley wagon referred to recently in these pages as having been exhibited at the Atlanta street railway convention, is the joint invention of J. R. McCardell, C. H. West and M. J. McDonald, who constitute the carriage building concern of McCardell, West & Co. of Trenton, N. J.

Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE Electrical Engineer.

Vol. XVIII.

DECEMBER 5, 1894.

No. 344.

COHERERS.

BY

Oliver J. Lodge

MY attention has been called to the very interesting observations of Prof. Elihu Thomson¹ and of Dr. Wm. J. Morton,² appearing in THE ELECTRICAL ENGINEER. Their explanation of the observed facts appears to me well-founded; it is quite true that a loose carbon contact will act as a coherer, though in my experience only as a delicate and troublesome one. Carbon, like platinum and gold, makes far too good a contact usually, without any electrical stimulus; so that a more oxidizable metal does better. I have not found anything stand better in the long run than iron. Brass in air, though at first extremely sensitive, deteriorates with age, becoming too much oxidized apparently, and so making too bad a contact; whereas brass in hydrogen, at first incredibly sensitive, gets too clean ultimately, and declines to make anything but a perfect contact. But iron seems to perennially keep, not over-sensitive, but very dependable and easy to work with.

ELECTRICAL MACHINIST PRACTICE.—XII.

BY

James F. Hobart

No workman in the world is more ready than the American mechanic to grasp any method or device that is new, particularly if it affords a short cut to the desired end. Especially is the electrical worker full of ideas new to the trade, and often new to himself as well. In the accompanying engravings, three ideas, probably new to some readers at least, are presented.

The device, Fig. 53, is intended for heating soldering bits. It is very simple and crude, yet effective. Branches are taken off of the mains as shown, and several lamps connected in parallel in one of the branches. One wire is then twisted around the shank of the soldering bit, and the other made fast around a piece of electric arc light carbon. The carbon is laid conveniently on the bench, and when it is desired to heat a bit, it is laid upon the carbon and then raised enough to form an arc. Current passes from the soldering bit to the carbon. This causes the copper to be consumed faster than if current passed in the opposite direction, but the copper heats faster than if current passed from carbon to copper. After the arc is established, the copper is held in position one or two minutes and during that time it becomes hot enough for use. Occasionally the performance is varied by attaching the carbon wire directly to the work to be soldered. This

method is very valuable in brazing, the metal being made to melt and flow very quickly. This should, I think, be a good way to solder aluminum.

The working of the device is as follows: The current due to the voltage (about 115), less the resistance of the arc, flows from the copper to the carbon. To obtain more current, another lamp is cut in, then another and another, until four are in parallel, as shown. Five lamps are shown in the figure, but the right hand one is not burning. As the original "system" was constructed, but four lamps were used and to get less current one or more would be partly screwed out of their sockets as shown by the right hand lamp, thus breaking the connection and allowing only four lamps to work. For very small bits, only one or two lamps need be used, but for very large ones, even more than five in parallel would be desirable. The heating by arc being entirely local, it is desirable to move the bit back and forth so as to heat all parts of it. Copper, owing to its great conductivity for heat, as well as for electricity, is very easy to heat uniformly, even by heat locally applied. Still, moving the bit causes it to heat much more quickly than when it is left in one position. The copper is not cut away so badly when the arc is shifted as when it remains in one place.

Fig. 54 illustrates a considerable improvement in the

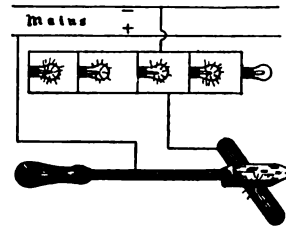


FIG. 53.

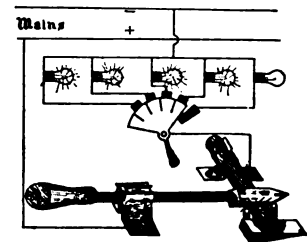


FIG. 54.

device, which still remains remarkably simple. The lamps are all connected to the return main as before, but instead of going altogether into the carbon, each lamp is connected separately to the contact pieces of a rheostat switch. The switch is of peculiar construction, being made to cover all the contact strips at once, instead of in succession, as in the usual manner. This is done by taking for the switch arm, a segment of metal wide enough to cover all the contact strips at once, and then slotting or slitting it in four places, so as to ensure five good contacts in as many independent strips. The lamps can remain screwed tight in their sockets, with this switch arrangement, yet the current can be graduated from zero to maximum, by the movement of a single lever. The same switch also answers to cut off current when not using the soldering bit. Another improvement is in getting rid of the wire, which in Fig. 53 was attached permanently to the shank of the soldering copper. As shown in Fig. 54, the positive wire is attached to a clip into which the shank of the copper can be squeezed, and easily withdrawn when the tool is hot. Another clip holds one end of the carbon. The other end is held loosely between two bits of wire drawn into the bench, and a wedge is placed under this end of the carbon for the purpose of adjustment. After putting the piece of carbon

1. ELCO. ENGR., July 4, 1894.
2. ELCO. ENGR., Oct. 24, 1894.

in its clip, the bit is placed as shown in the engraving, moved up against the carbon, and let go. The clip forces it into, and holds it in the position shown. The wedge is then adjusted until the carbon is just high enough to give the arc desired. The bit may then be heated, removed, put back, and heated again, without further adjustment of the wedge. It is only necessary to put the bit on the carbon, force the shank between the spring clips, then let go of the handle and the clip will do all the rest. With an ordinary bit, considerable adjustment can be had by simply turning the bit so that a side or a corner is presented to the carbon. It takes longer to tell of it, than it does to adjust the bit and heat it. The possibilities of this device are immense, the copper and carbon can easily be combined in a single tool, and the distance between them controlled by pressing a pair of handles like those of tongs or pliers, or the carbon can be placed in an axial hole drilled in the copper bit, and by feeding the carbon forward, an arc may be maintained inside the tool just back of the point.

Several forms of soldering tools, heated by internally arranged resistance wires, on insulating material, have been placed before the mechanic, but I have heard nothing of the arc heated soldering copper, shown in Fig. 55. This tool may be constructed so that the carbon is regulated by a screw, and a spring added so that it can be pushed forward to start the arc, the spring returning the carbon to its proper position as soon as the pressure is removed. Or, the mechanic can try his hand at building a "self feeding" attachment for the tool. There are great possibilities in this direction, and impossibilities too.

Fig. 56 shows a very handy way of mounting arc lamps in the shop, particularly in the erecting department where light is never required in the same direction on different work. The overhead traveller consists of a flanged pulley three or four inches in diameter, running upon plain bar iron $\frac{1}{2} \times 2$ inches. This is suspended by offset iron hangers in the usual manner, so that the pulley, which has a flange on each edge, can run free. The wires are looped as shown, so as to allow plenty of lateral movement to the lamp. But the novel feature is in the arrangement for moving the lamp by means of the cords and pulleys shown. The weight keeps everything taut, the cord out of the way, and holds the lamp still when brought to the required

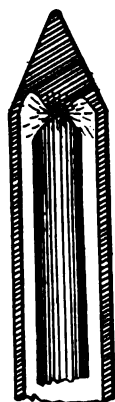


Fig. 55.

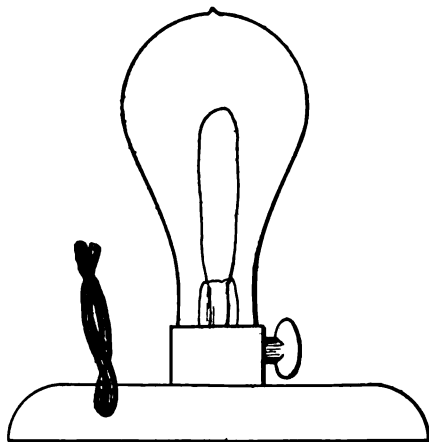


Fig. 56.

position. Trimming is done by moving the lamp to the right as far as it will go, when it can be reached by placing a ladder against the wall shown on that side of the room.

Another lamp arrangement is shown in Fig. 57; this time it is an incandescent lamp, and intended for use on a planer. It is of no use to tell how dark it is in some shops around the planer—the engraving shows that better than words—and to get light just where it is wanted, and keep the flexible cord from getting tangled up and broken, is

quite a problem—two problems, in fact. In Fig. 57, the lamp cord passes over two pulleys as shown, and the lamp is counterbalanced by the weight *a*. The lamp is surrounded by a wire cage so that it can be laid down in any position. The great trouble with this form of lamp is that it will not lie still, the movement of the planer causing it to roll all around on the platen. Fig. 58, shows a form of lamp stand which, with the addition of the wire cage, is very nearly perfect. This lamp may be set down, or it may be

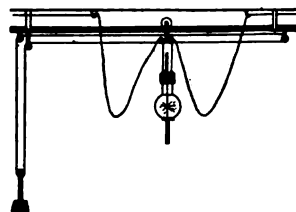


Fig. 56.

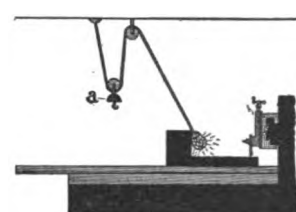


Fig. 57.

suspended by the lamp cord. In the latter case, it hangs nearly horizontal, inclined just enough to throw the light downward so that the base cannot cast a shadow on the planer.

In using this lamp on the planer as in Fig. 57, the weight *a* should be just heavy enough to take up the slack of the cord, and let the lamp go back and forth with the planer platen. Another small weight is provided, which, when placed on the hook underneath *a* will just counterbalance the weight of the lamp, thus allowing it to be placed at any required height.

ARMATURE-DISC CUTTING.

BY

Oberlin Smith.

IN reading the very interesting and practical articles of Mr. Hobart upon "Electrical Machinist's Practice," now being published in this journal, it occurred to me that an amplification of his first chapter upon the "cutting of armature discs," would be of interest, inasmuch as the description in question refers but briefly to the various methods available.

From the methods mentioned by Mr. Hobart, two at least may be eliminated, to clear the way for a consideration of the alternative methods which will probably have the monopoly in actual practice. The first of these is the milling of the notches in a group of discs (previously punched out in round cutting dies) when strung together upon an arbor, this being rather expensive and also apt to produce burs; unless indeed special precautions are taken for clamping the discs very tightly, the clamping washers themselves being provided with accurately cut notches. The second plan, which is out of the question for extended actual use, is the step-by-step method of indexing, it being practically impossible, where a large number of notches are involved, to make the pitch so accurate as to "come out" right at the end.

The only methods to be seriously considered are, therefore, the punching of all the notches at once; or, the indexing of the blank automatically for cutting one or more notches at a time. It is true that, so far, the attempt to make cheap and durable dies either for punching a complete notched disc, holes and all, at one stroke, or for producing all the notches at one stroke in a circular blank previously prepared, have not been in all cases successful, if indeed completely so, in any one case.

It is evident to any one acquainted with the construction and operation of cutting-dies that for notched armature

discs a complete male and female die of solid steel (either both hardened, or with one hardened and the other left soft enough to be hammered-up for repairs) are in the first place very difficult tools to produce. This is not so much because of the complicated contour of such dies, as from the difficulty of retaining the accurate shape and size desired during the process of hardening, which is sure in the majority of cases to shrink, swell or warp the piece of steel in question to an extent beyond the limits of accuracy required for such work, especially in the case of large diameters. It is furthermore a lucky circumstance if no cracking occurs. The mere milling out of the desired notches in a male die, is evidently cheaply performed in any ordinary gear-cutting machine, with a properly shaped milling-cutter, the accuracy of the indexing being equal to that of good cut-gearing, which is ample for the purpose. The production of its mate, the female die, is with ordinary tools vastly more difficult, such work usually being done by scribing the contour of the completed male die thereupon, followed by the shaping, slotting or planing of the notches, with the tool fed by hand to follow the scribe-marks. It is obvious, however, that such a female die could easily be attached to a special chuck, mounted upon the indexing spindle of a gear-cutter, or large milling-machine, and that a special milling-head, in the form of a projecting arm with the cutter compactly mounted at the end thereof, could be so arranged as to pass completely through the die—that is, in everything but very small sizes, say less than 3 or 4 inches in diameter.

A specially rigged-up, but not so very expensive, machine of this kind, would therefore produce the dies in question, with any pitch, length, width and shape of notches, at reasonable expense, and would solve the difficulties of the problem, *providing* such dies would *stay in shape* during the hardening process, and, furthermore, would be *good for anything*, in the matter of durability, after they were completed. As a matter of fact, however, these conditions do not exist; first, on account of the warping, etc., before mentioned; and, second, because the accidental breakage of even one tooth or the corner of a tooth would ruin the whole die. We therefore must abandon the use of completing dies, or must contrive a construction by which any part liable to breakage or undue wear can be quickly removed, and an absolute duplicate substituted.

Various composite constructions of the kind hinted at above have been attempted, some of them with a fair degree of success. As far as I know, however, the careful and systematic designing of such dies, with a view to the greatest possible interchangeability of parts, together with the cheap construction and repair thereof, has never been completely worked out. It is nevertheless true that it is well within the possibilities of any machine shop, properly equipped for fine tool-making, to make dies of this sort which would produce the notched armature-discs in question at a vastly cheaper rate than they can be made in any other way, as well as making them far more uniform than they can be if left to the tender mercies of a notching machine, which may not always be kept up to concert pitch, so to speak, in the matter of accuracy. I will not here attempt the specifying in detail of such dies. In general, it may be said that their "bodies" would be made of iron or mild-steel accurately indexed and milled to shape with proper special tools, which would be adjusted to suit any desired diameter and pitch. The inserted "teeth" of hardened steel would be all accurately ground to a standard shape after hardening and tested with limit-gauges. Such work of course requires careful designing and execution, but, when once started, need not be very expensive, providing the shop thus equipping itself can get plenty of such dies to make. This is an *if* worth considering.

In regard to the other available method of making notches, viz., by indexing, it may be said that it is perfectly practicable to get the "blanks" good enough by cutting them in an ordinary power press with round cut-

ting-dies accurately finished in a grinding-lathe after hardening. This may be done either by cutting the periphery first, and at the second operation punching the central hole, together with such bolt-holes or key-seats as may be desired, or, preferably, by combination dies which will produce the complete blank at one stroke. Such a process makes accurately true work and precludes any necessity for turning the armature-core after the discs are "strung up" upon their shaft. If, furthermore, these discs are to be notched there is no difficulty in getting them accurate enough with a quick-working automatic indexing press, cutting either a single notch, or a group of two or more, at each stroke. Neither would there be any difficulty in arranging a press for thus operating two or three discs at a time, as mentioned by Mr. Hobart, and shown in his Figs. 2 and 5, Sept. 19. It would, however, make the press somewhat expensive and more difficult than usual to keep in order, to arrange this double or triple indexing, and, in the latter case, the group of three discs would take so much room that a comparatively large press would be required, much larger and more expensive, indeed, than would be necessary for actually doing the work when mere power is taken into consideration.

There are in this country at least two general types of indexing presses for work of this sort. In one of them the spacing or indexing dial is placed below the disc to be operated upon, and requires that the same shall be somewhat smaller in diameter than are the inner ends of the notches, in order that it may swing clear of the lower, or female, die. In this machine the disc is clamped directly upon the upper surface of the dial, being guided by a projecting step or tenon entering the hole in the disc, made concentric with the axis upon which the dial revolves. Clamps are also provided to hold the disc down. The dial is provided with teeth at proper distances, driven by a reciprocating pawl which may be attached by any obvious mechanism, as pitmans, rock-shafts, etc., to an adjustable crank upon the main-shaft of the press. At the speeds used in practice its inertia must be controlled by a suitable brake or, in some cases, an automatic locking device.

In the other type of machine referred to, the disc is held between two clamping chucks, provided with a locating tenon as before, the gripping being done by the weight of a vertical shaft, and its appurtenances, upon the upper end of which is the indexing dial. This form has the advantage of using but one diameter of dial, and that of as large a size as desired (thereby obtaining greater accuracy) for all diameters of disc. It also puts the dial in a position where a simpler connection can be made to the press shaft. In either form of machine the dials will index a number of notches in the disc equal to the number of teeth in the dial or some divisor thereof. In the type now under consideration however, where, by the way, the dial itself can be a mere ring costing but little, the number of dials required is only such as to cover, with their divisors, all numbers of notches wanted upon the discs to be made. In the other, or what we may call the "bottom-dial" type of machine, this is also the case, but in addition, as before mentioned, various dials of the same number of teeth might be required, as neither sufficient accuracy, nor enough clamping surface can be obtained by working a very large disc with the very small dial which might be needed for the smallest diameters.

On the other side of the question it may be said, however, that the bottom-dial machine can be made somewhat stiffer and possibly a little simpler than can the top-dial kind. The latter is probably better where a great variety of work has to be done, while for running steadily upon one kind of work, especially if of large diameter, the bottom-dial system might in some cases be preferable.

Both the types of machine just spoken of as already on the market are limited in regard to speed, on account of the inertia of the reciprocating and intermittently moving parts, as it is not practicable to run them very much over

100 strokes per minute, except perhaps in cases where the disc notches are of small pitch. It is quite possible, however, to build a special machine adapted, say, for a comparatively small variation in the diameters of discs and number of notches required, which would run so smoothly as to be capable of obtaining a much higher speed. The chief difficulty with the present machines is that they attempt to be *too universal* in their adjustments.

To sum up the whole question, I should say that for making notched armature-discs by the million, at the rate, say, of from 5,000 to 15,000 per day, with one operator, the best system is to have the combination dies before referred to which will produce the disc complete at one stroke, notches and all. These dies might seem costly, but with proper provisions for cheaply duplicating the individual pieces, for easily taking apart and putting together and for quickly sharpening by grinding the ends of the inserted teeth, and setting them up to the proper level (without disturbing the sides, which would remain of a constant shape) the operating expenses would be small and the interest on the first cost would be a mere bagatelle when the speed of production obtainable with them is considered. Such dies should of course be used only when the motor or dynamo for which they are made has passed the experimental stage and is certain to be made in large quantities.

When, on the other hand, certain armatures are still experimental, or when they are for certain special uses only, thereby considerably limiting the demand for them, the best system is undoubtedly to notch them by the use of an automatic indexing machine. These machines, in either of the forms above described, have doubtless attained their universally adjustable and somewhat expensive character by a natural evolutionary process, there having been so very much experimental work done, by so many different experimenters, during the last few years as to make a lively demand for a few hundred discs of a certain kind, which perhaps in the next armature, or batch of armatures are superseded by something a little different. This experimental work, however, will probably become less and less in quantity as the practice of the art of designing and making dynamos gradually becomes standardized and unified. We may fairly expect, therefore, the future development of more cheaply-operated and durable combination dies for such armatures as are to be made in very large quantities; while those wanted in smaller batches will probably be made in simpler and quicker-running indexing presses, built each for its special work without attempting to be universal in its scope.

DIRECTION OF ROTATION IN ELECTRIC MOTORS.

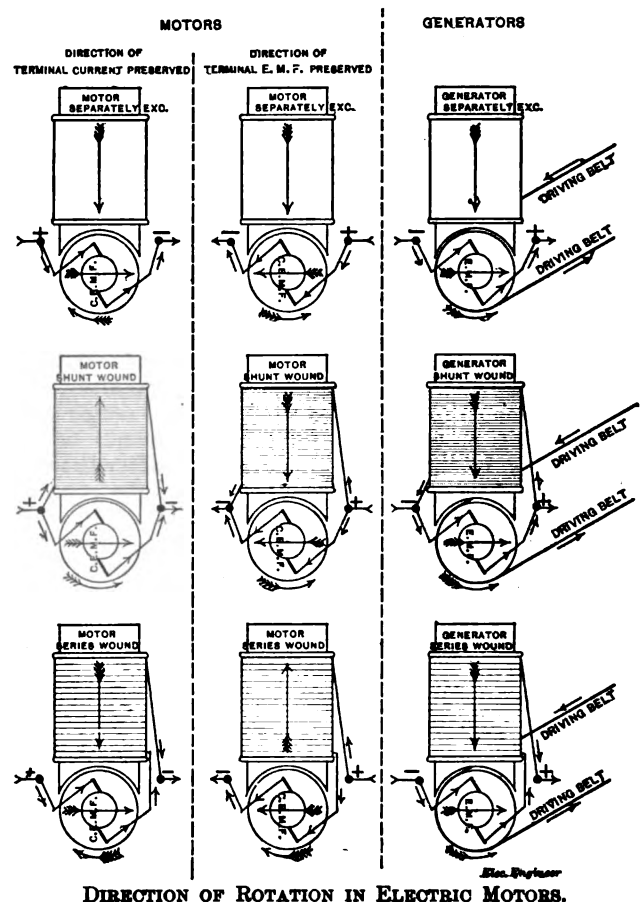
The effect of armature reaction, in a motor, is the same as in a dynamo, except that its relative direction is reversed. Since the rotation of a motor is produced by electro-dynamic force, the leading pole requires to have its flux density strengthened by armature reaction, and the following, or trailing pole, must be correspondingly weakened. In a generator, however, the armature has to be moved by mechanical force away from the denser flux, at the strengthened pole-piece, and, therefore, the trailing polar edge is strengthened by armature reaction. Consequently, the fact that the direction of both armature reaction and armature M. M. F. must be opposite in a motor to that which exists in a dynamo, is the fundamental law underlying all considerations of direction of relative rotation in motors and generators. It will thus be seen that in order to preserve the same direction of rotation of the armature as a motor that it possesses as a generator, the relative direction of M. M. F. between field magnets and armature must be reversed.

Shunt-wound machines will preserve their direction of rotation as motors, either when the current through them

retains the same direction, or when the E. M. F. at their terminals retains the same direction, as in their condition as generators.

Series-wound machines will reverse their direction of rotation as motors, either when the current through them retains the same direction, or when the E. M. F. at their terminals retains the same direction, as in their condition as generators.

In order to reverse the direction of rotation of a motor it is necessary to change the M. M. F. in either field or armature; i. e., to reverse the direction of either the field or armature. Merely reversing the direction of pressure at the motor terminals, or, what is the same thing, reversing the direction of current through the entire motor, does not change its direction of rotation unless the machine be separately-excited. These relations are indicated in the accompanying diagram, where the machines in



the uppermost row are separately excited, those in the middle row are shunt-wound, and those in the lowest row series-wound. The large arrows point out the directions of M. M. F. in field and armature, and the curved arrows the direction of armature rotation. It is evident that in order to retain as a motor the direction of rotation possessed as a dynamo, a relative reversal of M. M. F.'s in field and armature must be effected.

FLEXIBLE CARBON BRUSHES.

CARBON commutator brushes, as commonly used, consist of one or two blocks of carbon, pressed against the commutator by a spring to maintain the contact. In the case of street railway motors, subject to violent oscillations, the carbons are often jolted away from the commutator, thus causing sparks and burning of the commutator. The most which has been done to mitigate this is to introduce several carbon blocks, each with an independent spring. In order to dispense altogether with springs and, at the same time, to maintain the pressure constant, Professor

1. From *Electrical Engineering Leaflets*, by HOUSTON and KENNELLY.

George Forbes, of London, has devised a brush of flexible carbon, such as carbonized cloth, compressed into a metal case open at the side facing the commutator, the case serving both as a holder for the flexible carbon, and also as a terminal for the circuit.

The cloth is treated by the process adopted by Varley and others, which consists mainly in calcining or charring vegetable or other fibres saturated with a hydrocarbon fluid. When treated in this manner the cloth acquires conductivity, though otherwise it retains most of the properties of the cloth, and, owing to its flexibility, maintains contact with the commutator at an infinite number of points. By this means it is asserted a much better contact is maintained, which is not broken, or even varied, by the jolting on a railway car.

SOME ASPECTS OF ELECTRICAL EDUCATION.

BY

H. M. Stacy

I. The Education of the Electrical Engineer.

Evolution in the solution of problems of widespread interest usually follows certain hard and well defined lines, whatever be the character of the vexed questions. To trace out the history of the development of popular ideas, to balance the relations of cause and effect in each case, to be able finally to collect the best thoughts of the best thinkers who have dealt with these problems, and so outline their solution, is one of the pleasantest tasks a writer can perform.

The first step in this solution is an awakening to a need of a something, but ill defined, because the want is only vaguely comprehended. Usually the need originates when an end is desired, but the intermediate steps leading to its accomplishment are not perceived. This want expressed by a few is then echoed by others and extends until it becomes general. The more thoughtful begin to discuss and define both the end to be attained and the means for its accomplishment. Individuality or difference of opinion results and in a sense the question is divided along party lines. The factors at first are usually strongly opposed, the one being inclined toward a radical view, the other holding to a conservative aspect.

The human mind, whether it wills so or not, generally follows the motions of the pendulum. Once in momentum it swings to one side, then to its opposite; and finally, after swaying to and fro, loses its energy in useless friction and takes up the rest position, which is invariably the mean between the opposed points in its path. This tendency is so generally recognized that a saying has become a law that the truth is always to be found in the mean or compromised position between contending factions. This may be stated in another way: These opinion-oscillations, when their energy is expended in mutual friction, finally settle down to a position of general agreement and acceptance which may be termed the simple *common-sense* view of the question. The solution then invariably follows. Strange as it may seem, the popular mind, instead of taking a practical view of a question at first, only attains this through oscillations and errors which wear away the vagueness of the problems and lead to its clear and universal comprehension.

Though it is not the aim of this article to discuss primarily the philosophical development of the subject of electrical education as a specialized branch of general technical education, yet this treatment seems necessary, in part, to admit of the attempt to place a few aspects of the problem in as clear a light as possible.

It is requisite at the outset to realize the extent which this particular educational problem has assumed, and this is evidently as broad as the numerous and varied lines of electrical activity. Though apparent, it is by no means generally acknowledged that the educational training should be specifically directed towards the avenue of future application. This division of opinion has doubtless been influenced by the standpoint from which the question is viewed. One class looking forward insist upon the inculcation of general principles, leaving the filling-in of specific details to be dictated by the necessities of the work finally engaged in. Another class, dwelling on the demands of the specific work, insist that the training in general principles be strongly supplemented by careful attention to specific details. Many eminent writers have ably presented both sides, but as yet we are far from a common consensus of opinion. But the original lines of discussion are being rapidly outgrown, owing to the almost marvelous spread of electrical applications, and new aspects are being constantly presented, rendering the problem still more puzzling.

It is the aim of this article to attack the educational problem from the standpoint of the actual needs of those engaged in active electrical work, and to deal especially with a transient phase which is daily becoming more pressing. Just as a new shoot on a tree establishes itself on an older branch and draws its life from it, it was to be expected that the first endeavors to impart an educational preparation for the duties of the electrical engineer should be based upon the already well established courses in mechanical engineering. This at first was no doubt justifiable, for the early workers in electrical fields were compelled to face the problem of the adaptation of a new method for energy transformations to already existing mechanical principles. The first effort was to make a dynamo a mechanical possibility. The flat then went forth backed by some of the greatest scientific authorities that the proper training for the prospective electrical engineer should be at least nine-tenths mechanical. So far as the education of the mechanical engineer is based on fundamental training in mathematics, chemistry, and physics, there is now but little doubt that nearly all this training is equally requisite for the electrical engineer. The majority of our schools still adhere more or less closely to this division.

But a change in the mechanical aspects of electrical problems has slowly been taking place. The mechanical proportions and relations in the design of electrical apparatus have reached a point of somewhat general agreement. The mechanical considerations in electrical design are now rather secondary to the electrical conditions in any given device. The connection between the two will doubtless always be a vital one, but the point at issue is, Which aspect predominates?

The complete design of a dynamo deals with its shape, or the distribution of the metal constituting its frame work; with the strength of the metal in its different parts; with the mechanical friction of the moving parts;—all these elements are reduced to their smallest working proportions. But this is the mere skeleton. The question of the greatest moment is, that the dynamo shall show the highest efficiency and reliability under the conditions dictating its design. The iron must be considered as to its magnetic properties, and even the shape of the greater part of the frame work is guided more by magnetic than mechanical considerations. The electro-magnetic effects of the windings and the armature reaction, the extent of the heating losses in the iron are, after all, the vital aspects of the problem. In the early days of the electric railway, it was the mechanical possibility of propelling a car by electrical currents which had to be proven. Then followed the elaboration of the mechanical details of line, car, and station construction.

That which has made electrical traction not only the competitor but the superior of all other forms, has been its demonstrated efficiency, adaptability, and reliability. Experience is all the while demonstrating that the electric railway engineer must deal more with the electrical than the mechanical phases of his subject. The popular prejudice against the introduction of the overhead trolley is fast subsiding, but the greatest obstacle to the general introduction of the trolley in our larger cities is unquestionably an electro-chemical one. The prevention of the electrolytic destruction of gas and water pipes depends wholly on the amount of electrical and chemical knowledge which can be brought to bear upon it. The double trolley preventive is mechanically possible, but the electrical complications which it involves preclude its general adoption. But why carry illustration further? This tendency seems general whatever aspects of engineering duties are considered.

Important as these considerations may seem, it will not do to carry them to the other extreme. Ideally, both phases of technical training must be most carefully weighed. Their relative importance in the life work of the engineer must be ascertained, and this only should govern the extent of their application.

In almost every instance the science involved in electrical applications has originated in the schools, but the schools have never done the bulk of the work in their applications. Possibly in this way they have adhered too strongly to the original conditions, and neglected to see that their mission was to follow applications and fit men for dealing with them, as well as to originate new principles. It must always be largely the work of the schools to follow, and examine, and criticize. The difficulty with our schools has largely been lack of acquaintance with, and appreciation of, the practical applications of electricity, on the part of the instructors. As a consequence, courses have been too vague and general. Principles have been elaborated to a bewildering extent. Mathematics, physics, and chemistry have been taught with little reference to their coördination with the main element in the proper training of the prospective engineer. This lack of united and well directed work on the part of associated instructors has been emphasized upon the students, who, having the burden of coördination on their shoulders, have found the task burdensome in school and almost hopeless under the strain of their subsequent engineering duties. Such a condition of affairs would not long be tolerated in commercial operations.

The condition in which many of the schools leave their students may be exemplified by a fancied illustration. A certain manufacturer, realizing the demand for steam engines, determined to construct one and place it on the market. After

much consideration he concluded that it would be better to ascertain for what purpose his engine would probably be purchased, and then design and build one of the kind best adapted to this use. This did not seem practicable, however desirable; so he designed an all-around engine involving old, regulation ideas, and whose chief recommendation would be that it would run. "When this engine is purchased," he argued, "the buyer can have it over-hauled and adapted to the purpose for which he bought it." Upon completion, it was nicely painted and gaily decorated and advertised for sale. It was bargained for for one purpose and then another; in each case the would-be purchaser was suspicious it was too much of an engine; and besides, having no record and only backed by testimonials of good construction, as far as the design went, it did not sell readily. One person wanted to buy it for an agricultural engine, but decided not to invest in such complex machinery and so much ornament. Another inspected it for running a saw-mill, but concluded that it was not heavy enough to stand hard strains. A mine owner thought he could use it to pump water, but the price was prohibitive. Finally after many failures to dispose of it at the maker's price, it was offered for sale to the highest bidder. It so happened that it was purchased and placed in an electric light plant to meet a sudden emergency, since something must be had which would go. Its failure was complete and humiliating to its builder. It was in no way adapted to the work demanded of it. It was right handed where it should have been left; it ran over instead of under; its speed was too low, and when this was increased, it ran hot and cut badly; it was wasteful of steam and defective in nearly every respect. If this engine had been designed and constructed for agricultural work, to run a saw-mill, or operate a dynamo, it would without doubt, have performed its specific duty to the complete satisfaction of its designer, who, though he had never run an engine, yet had some excellent ideas and theories.

Experience has practically defined the extent of the preparation which may reasonably be demanded of young men for entrance upon a regular technical course. This cannot well be advanced beyond a certain point owing to limitations of age and expense. Within the limits, there yet remains much to be done. The preparatory work is not generally in the hands of men sufficiently qualified for their task, and so lacks not only directness but accuracy and scientific value. Were the preparatory training entirely in the hands of the better technical schools, much valuable time could be saved and the subsequent advanced work of the student might then be so greatly elaborated as to be above criticism. But there are obvious reasons why this cannot be realized. The technical course itself is again limited to four years, a limit which seems so well justified that it is doubtful if it will ever be expanded. Experience then has at least defined the educational problem in regard to the extent of the preparation and the length of the technical course. Nearly all the leading institutions have tacitly agreed upon the points at which the technical course should begin, but they differ widely both in the matter and manner of the course. Two things must be eventually determined upon,—the subjects which shall constitute the course, and the extent and method of their treatment. The time will doubtless never come when a common standard of matter and method will be agreed upon and adhered to, but it is reasonable to expect an approximation towards this end.

If the actual work of electrical engineers was thoroughly defined, the problem of preparation for it would be a simple one indeed. But this condition cannot obtain for many years to come, for advancement is too rapid. How then can necessary data be arrived at to serve as a guide in planning the matter and method of the technical course? The competent engineer of to-day is one who can do well what has already been done by others, but who at the same time has a sufficiently comprehensive grasp on the general scientific principles entering into his work, to enable him to effect new combinations or make radical advances. To train for such work, the contributory sciences must be taught thoroughly in their elements, and elaborated in the lines of their direct bearing upon the real work of the engineer. To this should be added both the theory and practice of the leading standard applications.

Taking technical courses as they exist at present, the teaching of the contributory sciences is open to grave criticism. In the perfectly organized school, not only the requisite mechanical engineering, but the chemistry, physics, and mathematics as well should be taught by men who themselves have first been trained for the electrical engineering profession, and subsequently specialized in their respective branches. They would then be well qualified to decide to what extent their subject should be presented and what particular phases most elaborated.

The severest criticism is always the full and plain statement of facts. There is to-day no distinctively electrical school. Our leading technical institutions offer mere courses which are but ramifications of a kind of general collegiate training in the sciences. In the majority of cases, the professors of chemistry, physics, and even mechanical engineering are content beyond a somewhat general idea of the subject to leave all matters electrical to the professor in that department. While this in itself may not be so objectionable, it has occasioned an embar-

assing situation. A technical college is an association of a number of departments placed on equality and each presided over by a specialist in his particular branch of work. The courses offered to the public are the result of mutual consultation and compromise. It is seldom a professor is sufficiently Napoleonic to define his own course through all departments and succeed in having his judgment followed. The professors in the other departments train the electrical students rather with reference to making them specialists in their particular lines. This can have but one result,—the confusion and overcrowding of the student. In their zealous but misdirected efforts they often pose as veritable Shylocks determined to have their pound of mathematics or chemistry, and proceed to execute their purpose with needlessly severe demonstration and examination. Reform must commence by insisting that in the ambition for high departmental scientific rank, they must cease endeavoring to do what is in reality post-graduate work.

As the work of the practical engineer becomes better defined, a division of labor results. It is becoming recognized that chemical analyses of copper, oils, etc., should not be expected to be made by the electrical engineer. Various mechanical problems are better solved by men working in the particular line in which they occur. All this is having its influence on the electrical courses.

A synopsis of the principal electrical engineering courses in this country shows that, with one or two exceptions, the specific electrical training does not begin before the third year, and does not become predominant until the first third of the fourth year is passed. An hour estimate of the contributory studies shows that this crowding out is largely due to the undue attention paid to the mechanical engineering aspect. It seems also that principles are too largely presented even in the meagre time devoted to electrical study. Owing to lack of time these principles are not repeated sufficiently in their various phases to insure mastery of them; and what may be termed dealing with actual practice does not receive its merited attention.

It is generally accepted that the student of mechanical engineering needs practical training in pattern making and wood working, in forging and machine shop practice. But are the needs of the electrical engineering student the same? It seems, that were the electrical studies begun at once in the first year of the course and continued with an increasing time allowance throughout the four years, better trained men and more acceptable to the commercial world would be the result. If wood-working and perhaps forging practice were to be omitted or greatly lessened in amount along with certain phases of shop-work, the requisite time for the much needed additional work in electrical lines would be obtained.

The synopsis further shows that much of the electrical work is done in physical departments. This seems open to criticism. Because our leading text books on physics generally conclude with a treatment of electricity and magnetism, it by no means follows that specifically electrical students should receive their training on the principles of these subjects in the department of physics.

But these criticisms may be summed up in a plea for a greater amount of, and more specific, electrical training, and a better coordination of the instruction in mechanical lines, and in mathematics, chemistry, and physics. A young man graduated as an electrical engineer, no matter how well qualified he may be to perform all the duties that his future work may demand of him, is no real gain to the world if his education has not caused him to transcend the mere engineer, and imbued him with a broad and truly scientific spirit. It is this, perhaps, more than anything else which will elevate the profession and lead to broader and grander applications of the marvelous force so widely influencing the world of to-day.

Department of Electricity.
ARMOUR INSTITUTE, CHICAGO.

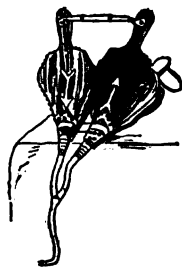
WELSBACH BURNERS IN COMPETITION WITH INCANDESCENTS.

IN a recent issue we printed a number of communications bearing on the possible influence on electric lighting of the introduction of the Welsbach burner. Supplementing what has already been published we give below an extract from a letter on the subject received from the manager of one of the largest electric lighting stations in the country. The writer says:

"To any one who considers that there is the slightest competition between gas and incandescent light, the Welsbach burner is, of course, a very serious question. I have had them in use in my house ever since I returned from Europe two years ago where I studied them pretty thoroughly. They are certainly far superior to the ordinary gas burner and save 25 per cent. of the gas. At the same time, they give an intensely disagreeable light and I do not think that any one would use them except from dire necessity. I have watched their introduction here with a great deal of interest and possibly, at first, with considerable doubt as to what would be the result. At the present time I do not think that they are making much headway, as we have had a number of people come back to us who had tried the experiment and been disgusted."

To the above we may add the following, communicated to us by another well-known station manager: A customer who had 8 arcs in a dry goods store, took them out and put in a lot of Welsbachs. He has come back to the arcs, as everybody objected; the light was distasteful and bad to judge by. The customer paid for the rewiring; but the Welsbachs have made a temporary difference of \$1,200 per month in his receipts.

THE GIBBONS RESUSCITATOR.



Dr. P. J. Gibbons, who applied for permission to experiment upon convicts executed by electricity in the New York State prisons with an apparatus designed to restore animation, has brought his apparatus to New York in order to place it in the hands of New York physicians for experiment.

The apparatus is designed to resuscitate persons who have undergone electrical shock, taken poison, been long immersed in water, or have suffered from a similar misadventure. To resuscitate it is necessary simply to restore breathing.

Dr. Gibbons's device is a simple double bellows, shown in the accompanying engraving. The end of the long tube is inserted in the mouth of the patient or, if this be closed, in an opening made in the throat. The patient's nose is closed, and when the handle of the bellows is raised the air rushes from the patient's lungs into one apartment of the bellows. Simultaneously the other apartment is filled with fresh air through a tube on the reverse side. This air is forced into the lungs by the compression of the handles.

Dr. Gibbons says that he has experimented on numbers of animals shocked by electricity, poisoned and affected by various ills of that kind with great success during the past eight years. He also claims that a large percentage of deaths from electricity are not instantaneous, and could be averted by using his invention. The voltage necessary to kill is not a fixed quantity. In State executions from 1,200 to 1,800 volts are used, whereas, he says, he is acquainted with one case where a man operating a dynamo received a shock of 4,600 volts, and was resuscitated by ordinary methods after seven minutes. In another case Dr. Gibbons's own assistant, a Mr. Greenwood, received 1,500 volts and was restored. D'Arsonval reports a case where a man received 5,000 volts and was resuscitated after half an hour.

EAST BOSTON ELECTRIC RAILWAY POWER STATIONS.¹

A new electric power station has just been completed in East Boston, Mass., for a small 26-car line operated by the West End Street Railroad Company, from designs made by F. P. Sheldon, M. E., of Providence, R. I., also engineer of the Union Railroad Company's electric power station in Providence.

The site selected, on East Eagle street, was such as to require nothing unusual in the foundations. An abundant supply of water for condensing purposes was to be had from the Charles River, which was, however, at a distance of 700 feet from the power station. Its mean low-water level was about 15 feet lower than the floor of the proposed station. A plan and section of the station are shown in the accompanying engraving.

The building rests upon a clay bed and covers an area of 72 x 67 feet. It is of red brick with terra-cotta coping, granite sills, and tile roof. A layer of concrete 18 inches in thickness was laid under the engine and boiler rooms to support the engine and boiler foundations. The boiler room contains the four vertical Corliss water leg boilers and the condenser plant, the latter being placed there so that the one boiler attendant can take care of the boilers and the air pump for the jet condensers and thus leave the engineer to look after the engines and dynamos.

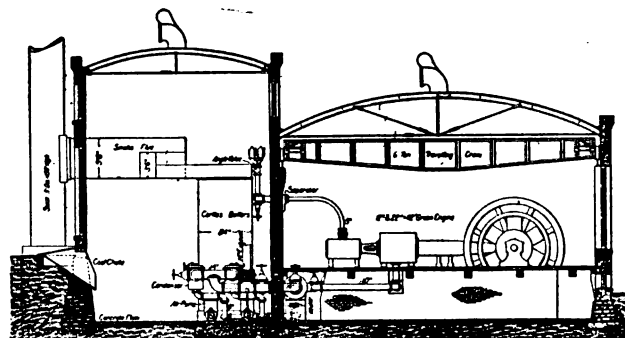
The boilers and steam piping in the boiler-room were furnished by the Corliss Steam Engine Company, of Providence, R. I. The steam main is divided into three sections by two Chapman valves. Connections for the auxiliaries of the plant, the pump injectors, etc., are all made at the bottom of the steam main, while the 6-inch steam pipes for each engine run horizontally into a De Rycke separator, from which a bent wrought-iron pipe leads to the engine. Each section of the steam main is drained by a pipe which leads the condensation back into the boilers.

The Greene engines, of which there are three, were built by the Providence Steam Engine Company, Providence, R. I., and are of the tandem compound type with 12' and 22' x 42' cylinders. Each engine is rated at 250 horse-power and will work under a steam pressure of 180 pounds. As the valve motion of the engines allows a cut-off up to three-quarter stroke, each engine can develop 400 horse-power when necessary. During the greater part of the day and night one engine will supply all the power needed. At the times of maximum load, as in the

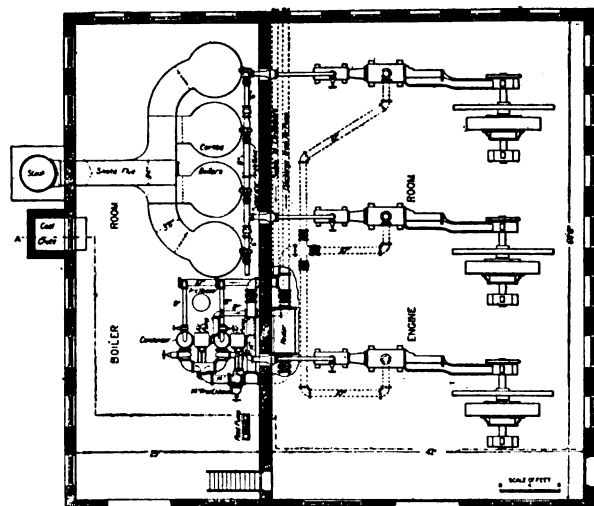
morning and late in the afternoon, the load will be sufficient to require two engines, leaving the third engine as spare one in case of a breakdown. Ordinarily two boilers will give sufficient steam to run the engine. There is a surplus of one boiler under all conditions. One is allotted for supplying steam to heat the large carhouse which is being built on the same site at the power station.

The armatures of the generators are bolted directly onto the shafts of the engines between the flywheel and the outboard bearing. The flywheel is 14 feet in diameter and weighs about 25,000 pounds. The dynamos were built by the General Electric Company for an output of 400 kilowatts each.

The exhaust piping of the engines is shown by dotted lines in the plan, and by following these from the engines it will be noticed that they all run into a large cross, a valve being placed in each, so that any exhaust pipe may be cut out when the engine is not running. From the cross a 14-inch pipe leads to a 500 horse-power National feed-water heater provided with a by-pass as shown. From the heater the steam can either be discharged into the atmosphere or to either one or both of the jet condensers and air pump. The condensing apparatus was furnished by the Deane



VERTICAL SECTION ON LINE A-A OF PLAN.



SECTION AND PLAN OF THE NEW EAST BOSTON ELECTRIC RAILWAY POWER STATION.

Steam Pump Company, of Holyoke, Mass. The exhaust steam from the air pumps and feed pumps will pass through a small auxiliary heater.

The condensing water from the Charles River 700 feet away, flows by gravity from the river to a settling chamber close to the power station through an underground wooden pipe 2 feet wide and 18 inches high on the inside, made of 2-inch yellow pine plank put together with copper nails. The salt water from the river enters this pipe through a rectangular strainer box 8 feet long, 4 feet wide, and 4 feet high, the top and bottom of which are of plank, and the sides of copper wire netting of 1/2-inch mesh. The centre line of the wooden pipe is 3 1/2 feet below mean low water. The settling chamber on the other end of this pipe, next to the power house, is cylindrical, 6 feet in diameter and 23 feet deep, and is made of brick. The wooden pipe enters within 3 feet of the bottom. A 10 inch supply pipe leads from a point near the bottom of this settling chamber to the condensers. As this is only a lift of 20 feet, no pump other than the air pump is required to raise the water to the condensers because of the vacuum in them. The discharge from the air pump is carried out of the building and empties on the flats that lie between the power station and the river.

The roof of the building is supported by ordinary iron trusses

1. Abstract from *The Engineering Record*.

of the bow-string type, built by the Boston Bridge Works, which also supplied the six-ton traveling crane over the engine-room. The iron trusses are placed on 8 foot centres and support the fire-proof tile roof, that was put on by the Guastavino Fireproof Construction Company, of 444 Albany street, Boston.

THE SYRACUSE STORAGE BATTERY FOR TRACTION, CENTRAL STATIONS AND PRIVATE PLANTS.

SOME time since THE ELECTRICAL ENGINEER noticed some of the excellent work accomplished by the Syracuse Storage Battery Company's accumulators in electric railway work. In view of the unusual interest now attaching to electric traction without overhead wires a description of some of the later work accomplished by these batteries will not be amiss. The appearance of the Syracuse battery plate is shown in Fig. 1. The active

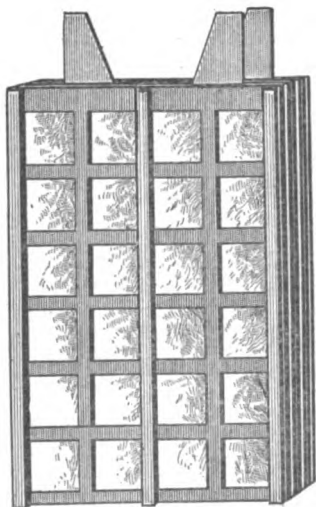


FIG. 1.—SYRACUSE STORAGE BATTERY PLATE.

material is held in its proper place by a glass retainer combined with a perforated confining plate. Each electrode is thus practically boxed in, and, at the same time, the thinness of the plates insures a very large discharging surface for the entire cell. The element shown is known as the "infant" size. It is claimed that it is impossible to short circuit or buckle one of these plates, as the active material is firmly held in every spot, yet so delicately that the electrolyte has free access to every particle of the plate's surface. The internal resistance is said to be low, and the cell gives up its current easily and can be discharged at very high rates without injury.

The illustration, Fig. 2, shows the motor car of the company

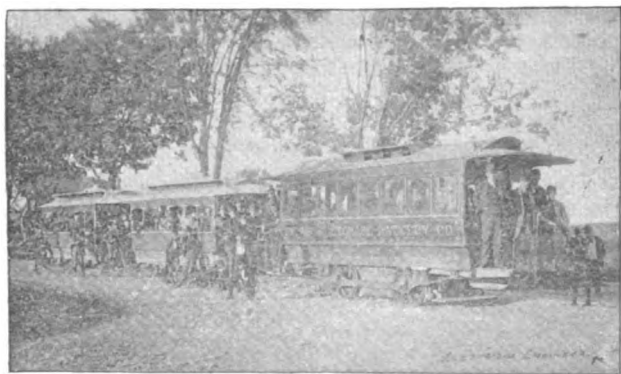


FIG. 2.—SYRACUSE STORAGE BATTERY CAR.

as it appeared on the tracks of the Oneida Street Railroad, Oneida, New York, where, with two trailers attached, it is claimed the greatest mileage ever made by the storage system was attained, the total run on one charge of the battery being 117 miles. The car was for a time run in an experimental way over all the grades and curves in the city of Syracuse, N. Y., without a single failure. A car with the same system is now in operation in Chicago,

which has run, up to the present time, over 10,000 miles without showing any signs of deterioration in the positive plates of the cells. The cells used in the Syracuse car made over 8,000 miles of traction work and are now being used for lighting purposes, being now nearly two years in use.

Below we give the opinion of the electrical expert of the Consolidated Electric Storage Co., upon whose judgment they depend in deciding whether or no a license shall be granted. The cell was taken out of circuit in the car and sent without any previous effort to make a special selection. After a detailed description of the construction, etc., the report is summed up briefly as follows: "The cell possesses several interesting and meritorious features. The plates are very simply made and the method of separation makes the completed element a solid pile well adapted to stand rough treatment. The weight, 60 pounds, would seem a little excessive for street car work but the main consideration is, of course, *durability*, and on this point relying upon the statement and affidavits of the manufacturers and the officers of the Oneida Street Railway Co., who state that this cell, in addition to lighting and other work, has made over 8,000 miles of traction work, I will say, that with about 8,500 pounds of battery (elements only) per car the record is a very satisfactory one, as the plates exhibited show no signs of rapid depreciation."

For lighting, the accumulators are put in lead lined wooden tanks or large glass jars, the number and size depending upon the voltage required and number of lights used.

Fig. 3 shows a physician's case of two cells with a rheostat, running a small fan motor. This case is designed for cautery

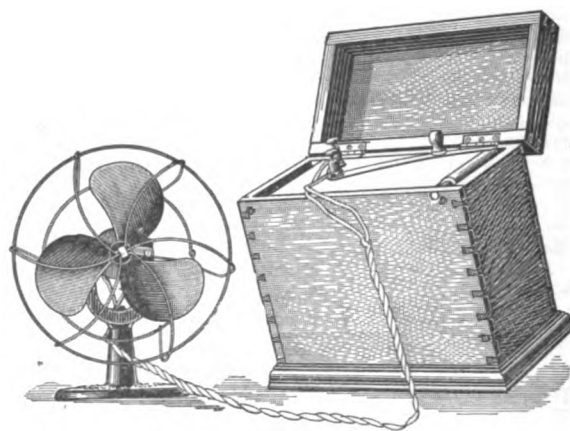


FIG. 3.

purposes etc., and has been found valuable in a variety of electro-therapeutic work.

We may add that the Syracuse Storage Battery Co., is licensed under the Brush storage battery patents by the Consolidated Electric Storage Co.

PERSONAL.

SIR DAVID SALOMONS, Bart., well known as the author of "Electric Light Installations and Management of Accumulators," and a member of the Council of the London Institution of Electrical Engineers, has been elected mayor of Tunbridge Wells, England.

OBITUARY.

AMHERST E. WILDER.

It is with regret that we announce the death, on November 12, of Amherst E. Wilder, of Saint Paul, Minn. Mr. Wilder was one of the most prominent and successful business men in Saint Paul and in the North-west, being largely interested in railway construction and actively connected with the business management of several of the leading banks and mercantile and manufacturing interests in Saint Paul and elsewhere. He was President of the Superior Water, Light & Power Company of West Superior, Wis., which position he has held since the inception of the company and to his ability as a financier the success of that corporation is largely due.

'TIS EVER THUS.

Pelham Manor residents are anxious for the extension of the trolley road to their village. There was some opposition to such a move a short time ago, but it is believed that the village trustees would now gladly grant a franchise if application were made.—N. Y. Evening Post.

DISTRIBUTION OF LIGHT FROM ARC LAMPS.¹

BY RANKIN KENNEDY.

The light is thrown out from the arc in a continuous current circuit, principally in the form of a cone having its apex at the arc and its base on the ground; this is a favorable circumstance, and is taken advantage of to the fullest extent in street lighting by arc lamps.

For interior illumination the lower carbon is made sometimes the positive carbon, and the cone of light thrown up on to a white ceiling, or a white disc above the lamp, a method first

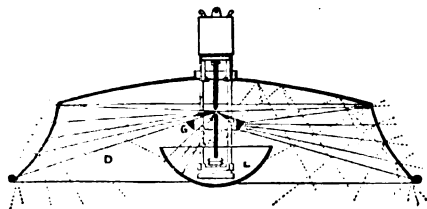


FIG. 1.

used at the 1880 Paris Exhibition by Jasper, in lighting the Art Gallery.

An arrangement by Siemens & Halske for the same purpose consists of a diffuser hung over an ordinary lamp. This diffuser is like a reflector in shape, and is about 8 feet 6 inches or 4 feet in diameter at the mouth, and is painted white inside; it is shown at D, in Fig. 1.

A bowl-shaped reflector, or, in other words, a common enamelled iron bowl, white inside, L, is hung below the lamp and serves the double purpose, reflecting light up into the diffuser and receiving any ash or carbon falling from the arc.

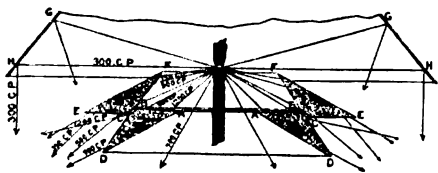
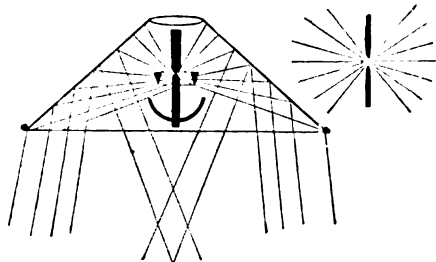


FIG. 2.

Such an arrangement is quite old, and is used in photographic electric lamps by Gwynne.

But a new and interesting addition for street lighting is shown at G, a ring of polished glass of triangular section. This ring receives the most intense cone of light from the arc, and deflects it on to the white surface of the diffuser, as shown by the divergent lines; with this arrangement a beautifully uniform illumination is produced. The lamp, of course, must be a focussing lamp; the glass ring is best built up of four or six segments of glass held in a light metal frame; the diffuser is umbrella shaped and made of canvas on a wire frame, and painted inside with



FIGS. 3 AND 3a.

white lead. The whole arrangement is light and cheap and easily applied to any focussing lamp.

An arrangement like this is quite rational and far superior to the insane practice of using semi-opaque globes over arcs in street lighting; these simply cut off from 80 to 60 per cent. of the light produced, and do not in any way assist the diffusion or distribution of the light. It can never be accepted as good sense to generate at great expense a powerful light of, say, 600 candle-power, and then to carefully cut off 200 candle-power of it in absolute waste, yet that is what is done in every arc lamp with a semi-opaque globe on it.

In this arrangement (Fig. 1) the arc is about 8 or 9 inches from the upper surface of the diffuser, which is, altogether, about 18 inches deep.

Prof. Anthony, who is a prominent authority on arc lighting in America, proposes another scheme for distributing light from arcs.

Fig. 2 illustrates his method: two rings of glass, A B C, D E F, of cross-section shown, are fixed with the arc on a level with the upper edge, H, G. H, G is a reflector above the arc, which receives the upward thrown light and sends it to light up the space immediately below the arc. By means of the prisms the strongest rays are sent furthest off, as will be seen by following the path of the 1,200 C. P. ray in Fig. 2.

This is rather an elaborate arrangement, but still, as it would give at least four times more light, evenly distributed, compared with the semi-opaque globe, it may be cheaper in the end to use it.

The idea is not to waste about half of the light in an endeavor to soften it, but to screen off the actual light and diffuse or reflect it from a large white surface.

An alternating current arc requires a very different form of rings of glass, and also a different form of diffusing surface. A plain cone, Fig. 8, is best for this purpose, as the light is thrown from the alternating arc in a diverging ring as in Fig. 8a.

The usual arrangements of large diffusers are very hideous looking affairs, but where arc lighting is to be adopted on any large scale it is easy enough to make them both effective and artistic with the aid of the architect.

SOCIETY AND CLUB NOTES.

MEETING OF THE NEW YORK ELECTRICAL SOCIETY.

At a meeting of this society held at Columbia College on Nov. 22, Mr. Gano S. Dunn read a paper on "Direct Current Motor and Dynamo Design." The lecturer illustrated his remarks by diagrams and brought out a number of important points which are usually lost sight of, as well as a number of novel arrangements, among them several new forms of winding.

Secretary George H. Guy, has just issued the programme of the Society for the season 1894-95 which contains the list of lectures to be given, in addition to those which have already taken place. They are as follows:

"Some Leading Phenomena and Principles of the Alternating Current," by Mr. C. S. Bradley.

"The Production of the Higher Forms of Carbon (such as Carborundum, Diamonds, etc.) by Electricity," by Mr. E. G. Acheson.

Visit to the Metropolitan Art Gallery and Museum, with a lecture on "Interior Lighting," by Mr. Luther Stieringer.

"Niagara on Tap: A lecture on the Details of the Water-Power of Niagara," by Mr. T. C. Martin. The lecture will be illustrated by lantern slides made from photographs taken specially for the lecture.

"The Doctrine of Unity in Electricity," by Dr. Michael I. Pupin.

Visit to an electric lighting station.

Talk on "Street-Railway Practice in the United States," by Mr. C. B. Fairchild. The lecture will be based on personal observation in a trip across the country and through the South, and profusely illustrated by lantern slides.

"Use of the Electric Light in Lantern Projections," by Mr. E. L. Hopkins. In this lecture the incandescent light and the arc light will be shown on the screen under varying conditions, and the volt meter and the ammeter will also be visible, so that their readings can be followed with all the changes in the power of the light.

"The Static Machine and Its Use and Office in Electrotherapy," by Dr. W. J. Morton.

Any person of good repute, who is connected with or interested in electrical work, is eligible for admission to the Society. An application blank will be forwarded by the Secretary on request. The entrance fee is \$1.00, and the yearly dues are \$3. The Secretary's office is at No. 5 Beekman St.

ELECTRICITY FROM WATER POWER IN OREGON.

A company has been organized at McMinnville, Ore., for the purpose of constructing an electric light and water system, to bring water from the hills two miles north of town. The city has passed an ordinance granting them the use of the streets for the purpose named. The water system is to be completed within twelve months and the electric light plant within eighteen months from the date of the passage of the ordinance.

THE PELTON WATER WHEEL CO. of San Francisco, report the business outlook as improved, and expect that after the turn of the year there may be an even more marked improvement. The revival in the electrical field opens up much new work.

1. London Electrical Review.

THE ELECTRICAL ENGINEER.

[INCORPORATED]
PUBLISHED EVERY WEDNESDAY AT
203 Broadway, New York.

Telephone: 1323 Cortlandt. Cable Address: LENGINEER.

GEO. M. PHELPS, President. F. R. COLVIN, Treas. and Business Manager.

Edited by
T. COMMERFORD MARTIN AND JOSEPH WETZLER.
Associate Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue,
Boston, Mass.

Western Editor and Manager, C. KAMMEYER, 1439 Monadnock Building, Chicago,
Ill.

New York Representative, 203 Broadway, } W. F. HANKS.
Philadelphia Representative, 916 Betz Building, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada, - - - - -	per annum, \$3.00
Four or more Copies, in Clubs (each) - - - - -	2.50
Great Britain and other Foreign Countries within the Postal Union " - - - - -	5.00
Single Copies, - - - - -	.10

[Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1888.]

EDITORIAL ANNOUNCEMENTS.

Addresses.—Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of THE ELECTRICAL ENGINEER. Communications for the attention of the editors should be addressed, EDITOR OF THE ELECTRICAL ENGINEER, 203 Broadway, New York City.

Communications suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.

VOL. XVIII. NEW YORK, DECEMBER 5, 1894. No. 344.

CONTENTS.

EDITORIALS:—	PAGE
High Lamp Efficiency and Regulation.....	458
Indexing Engineering Literature.....	459
Storage Battery Consolidation.....	459
Leaderette.....	459
ARTICLES:—	
Coherers.....	OLIVER J. LODGE, 449
Electrical Machinist Practice.—XII. (illustr.).....	J. F. HOBART, 449
Armature Disc Cutting.....	OBERLIN SMITH, 450
Direction of Rotation in Electric Motors (illustr.).....	452
Flexible Carbon Brushes.....	452
Some Aspects of Electrical Education.—I.....	W. M. STINE, 453
The Gibbons Resuscitator (illustr.).....	455
East Boston Electric Railway Power Stations (illustr.).....	455
Syracuse Storage Battery for Traction, Central Stations and Private Plants (illustr.).....	456
Distribution of Light from Arc Lamps (illustr.).....	RANKIN KENNEDY, 456
Electric Lighting and Power in the New Manhattan Life Insurance Building.....	463
NEWS AND NOTES:—	
Walsbach Burners in Competition with Incandescents.....	454
Electricity from Water-Power in Oregon.....	457
PERSONAL:—	
Sir David Salomons.....	456
OBITUARY:—	
Amherst E. Wilder.....	457
SOCIETY AND CLUB NOTES:—	
Meeting of the New York Electrical Society.....	457
ELECTRIC TRANSPORTATION DEPARTMENT:—	
Electric Railway Work in Chicago. (illustr.).....	460
Notes on Electric Tramways in the United States and Canada. (illustr.).....	H. D. WILKINSON, 461
Selecting Rapid Transit Routes in New York.—Trolley Franchise Litigation in Indianapolis.—A New Hose Bridge. (illustr.)—Electric Railway Extension at Montpelier, Vt.....	462
Big Trolley Deal in Trenton, N. J.—Brooklyn Motor Men Want More Pay.—West End Railway Company Election.—Winter Track Laying in Cleveland.—Electric Railway Bond Issue in Chicago.—The Mahoning Valley Electric Railway.....	463
LETTERS TO THE EDITOR:—	
Water Power Generators.....	WILEY & WARNER ELEC. CO. 464
Fly-Wheel Accidents (illustr.).....	J. D. C. 464
INVENTORS' RECORD:—	
Classified Digest of U. S. Electrical Patents Issued Nov. 20 and 27, 1894....	465
TRADE NOTES AND NOVELTIES AND MECHANICAL DEPARTMENT:—	
Awards for Signal Office Supplies.—Great Western Manufacturing Co. in Trouble.—The New Helios Direct Current Arc Lamp (illustr.)—New York Notes.....	466
One Month with the Mather Machines.—Storage Battery Traction in Cleveland.—Supplies for the Weather Bureau.—Leather Belts.—Awards for the Oerlikon Works.....	467
New England Notes.—Western Notes.—Southern Notes.—Rae Electric Mfg. Co.....	468

HIGH LAMP EFFICIENCY AND REGULATION.

IN commenting last week on the views expressed by Mr. Edison in a recent interview, as to the advantage to both the central station and the consumer to be derived by selling light and not current, and by the use of high efficiency lamps, the truth of these propositions was admitted and the adoption of that plan advocated by us. We are still of the same opinion, but a further consideration of the subject will serve to show that in order to carry out such a plan successfully, involving as it does a liberal use of lamps, important improvements and changes in station operation would have to be effected. It is safe to say that comparatively few stations could, under present conditions, improve the quality of their lighting or their profits, by using high economy lamps without first greatly improving their regulation. There is no denying the fact that lamps started at 3.1 watts per candle deteriorate much more rapidly in candle power than the same quality of manufacture started at a lower economy. Where the regulation is bad, the deterioration is, of course, much greater, requiring the lamps to be broken very early in their life, if the average candle power of the lamps in use is to be maintained at a high standard. If station managers can be brought to realize that life is not the only important factor in a lamp and that lamps which have deteriorated below some given standard should be weeded out, the next step they will, and must, take, is to improve the regulation on their circuits and to adopt as high an economy lamp as will give the best results with the conditions obtaining. How to effect this desired regulation may appear to be more difficult of attainment than is really the case. Experience has shown that where no checks are kept on the attendants in charge of the regulating apparatus large variations of potentials are met with, but that where recording apparatus has been introduced, a uniformity of regulation scarcely deemed possible has been attained. Only recently we had occasion to inspect the record charts of an alternating station; these showed that at the time the recording voltmeters were introduced the variation of pressure sometimes exceeded 10 per cent., and that the pressure was never constant for more than a few minutes at a time. After a few weeks' use of the recording instruments the maximum variation of pressure had fallen below 2 per cent., and the attendants vied with one another in showing a smooth curve at the end of the day's run. The result has been a marked saving in the lamp account. The carrying out of such a plan of regulation on the ordinary three-wire system with pressure wires carried back to the station from the feeder ends is a comparatively simple matter, and the pressure indicated on these wires gives, within permissible limits, the pressure supplied to the lamp terminals. The pressure recording methods now in general vogue among alternating stations, is, however, scarcely calculated to afford that constancy of regulation required for high efficiency lamps. The indications of the station transformers do not show what is going on at the end of the feeder; while on the other hand pressure wires brought back to the station from the end of the feeder afford no accurate indication of what is going on in the secondary circuit of the transformer. With the two variable factors of feeder and transformer

losses, depending on the load, the best regulation requires the pressure to be read beyond the transformers, in the secondary or lamp circuits. Of course, such a plan could hardly be carried out under the old methods in which each consumer is supplied with an individual transformer; but the more modern arrangement by which a bank of transformers, or a large single transformer feeds a secondary network, readily permits of such a method without involving too great multiplication of regulating apparatus. The time can not be far removed when a pressure recorder will be deemed as necessary to an electric lighting circuit as a safety valve to a steam boiler.

INDEXING ENGINEERING LITERATURE.

THE time has long since passed when the reader or student, however industrious, could keep up with the literature of even a single branch of electrical engineering, let alone the entire field. Recourse must therefore be had to a process of selection of those articles which seem best calculated to give the information desired by the reader if he would have time left for any other work. For those who carry on investigations, a rapid method of obtaining information as to what has previously been done in any given field is of a value which can only be appreciated by those who have had to spend valuable time in looking over the files of periodicals dating back for a number of years. A comprehensive index of electrical literature and of engineering literature in general is therefore a necessity which is making itself more and more felt as time passes, and the attempts which have been made to satisfy the general demand show that the want is duly recognized. In his paper, read before the American Institute of Electrical Engineers, on "Suggestions for an Index of Engineering Literature," Prof. Geo. D. Shepardson has done well to call attention again to the necessity for concerted action in this direction, and throws out a number of valuable hints as to the manner in which this work can be accomplished. All those who have given the subject any thought will agree with Prof. Shepardson that a work of this kind, even if confined to electrical engineering alone, in order to be properly carried out, can only be accomplished by the co-operation of a considerable number of workers, to each of whom should be delegated a special division of the subject. Prof. Shepardson mentions a number of indexes which have been attempted in the past and some now in course of publication, but to his mind they all lack that completeness which gives an index its real value. He also points out the patent fact that up to the present time none of these indexes, when published by private individuals, has paid, and here we think is to be found the explanation for the non-appearance of the ideal index. The most perfect piece of work of this nature which has yet come under our observation, and which seems to have escaped the attention of Prof. Shepardson, is the German index, entitled *Fortschritte der Elektrotechnik*, which is by far the most useful index to electrical literature that we know of. It is published quarterly and indexes the electrical articles appearing in sixty electrical and other scientific journals in English, German, French, and Italian. What gives this work particular value is the inclusion of short abstracts accompanying four-fifths of the references and covering the entire book literature indexed. The classification by subjects and by authors' index is such as to make the search for any particular article the work of but a very few minutes. The completeness of this work will be apparent when we state that the index for 1891 contains nearly six thousand references.

One would imagine that such a work would not languish for lack of support, yet even this truly monumental undertaking would have gone to the wall had it not acquired the guaranteed support of the German Postal-Telegraph Department and that of a number of German electrical firms. Prof. Shepardson suggests that the representative engineering societies might take up the publication of an index such as he outlines; but while they might well undertake the compilation and editing of such a work we fear that the capital required to carry it out would be such as to make it beyond the reach of such societies. But there appears to be no good reason why the publication, pure and simple, should not be placed in the hands of private parties, who, taking all the financial risks, would leave the societies unhampered on this score; while on the other hand the stamp of authority given to the work by the engineering societies would go far towards giving it a circulation among their members and others which would guarantee a working profit to the publisher. We hope that Prof. Shepardson's suggestions will not be allowed to remain unacted upon, and we shall be glad to aid in any movement looking towards the consummation of so desirable a work.

STORAGE BATTERY CONSOLIDATION.

STORAGE batteries and storage battery companies have come—a many—during the last dozen years, but few have come to stay. Too often both batteries and companies have had little value in them, except on paper—flamboyant circulars and handsome stock certificates. THE ELECTRICAL ENGINEER has, however, persistently expressed its conviction that the storage battery would surely become one of the most important resources of electrical engineering, that its practical defects would be eliminated and that its industrial exploitation would eventually get into proper channels. Much has been accomplished in these directions of late; the successful operation of large plants has shown the economic value of electrical storage, while competent and far-seeing men of affairs have undertaken the manufacture and commercial introduction of accumulators.

We are able to state that a concentration of effort is about to be consummated which will consolidate the interests, patents and business of the leading competitors under the control and management of men whose industrial and financial skill and experience in other fields assure an intelligent and aggressive development of the storage battery, practically and commercially. A strong organization with ample capital, and possessing hitherto conflicting and important patent rights, may fairly be expected to produce the best storage battery now possible, and to achieve business success.

Coharers.

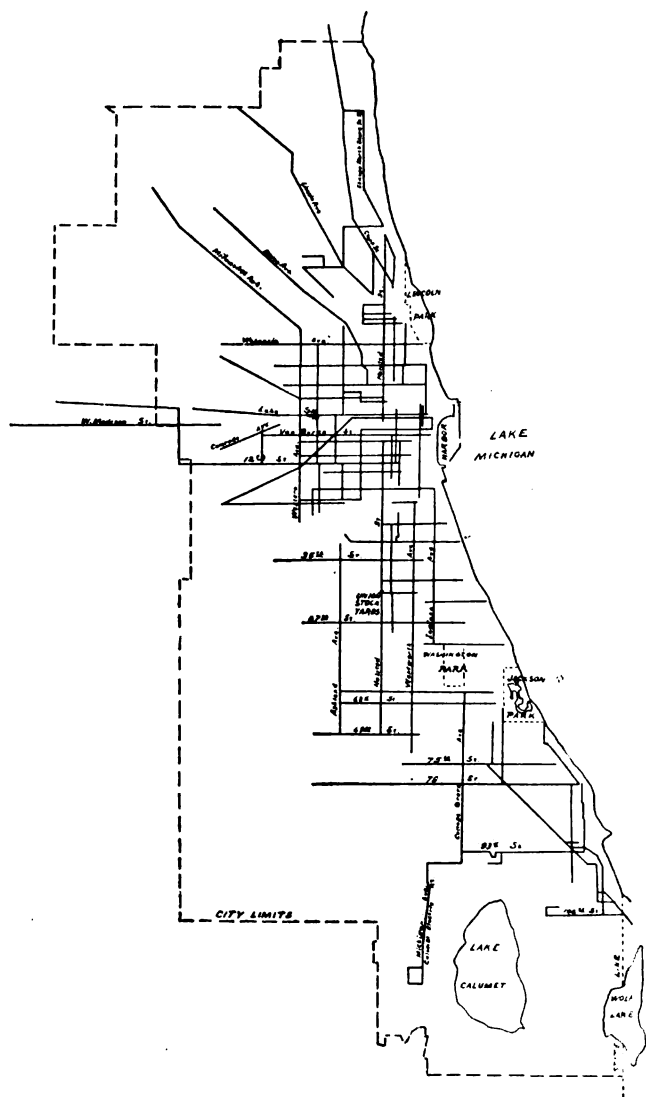
WE print on another page a communication from Dr. Oliver J. Lodge, called forth by observations of Prof. Elihu Thomson and Dr. Wm. J. Morton on coherer phenomena. Dr. Lodge's experiments seem to show that the least oxidizable metals do not make the best coherers, and that there is considerable difference in the action of the more oxidizable metals, depending probably on the conductivity of the oxide formed. Iron, it would appear, is best adapted for ordinary working, owing to its constancy of action. With these new detectors of Hertzian waves in the hands of experimenters, an increased sphere of action is opened up, which cannot fail to increase our knowledge on a subject of the greatest practical as well as scientific moment.

ELECTRIC TRANSPORTATION DEPARTMENT.

ELECTRIC RAILWAY WORK IN CHICAGO.

Probably nowhere is there so much activity in electric railway building at present as in Chicago. In all the three divisions of the city, the north, west and south sides, the construction of the projected electric lines is being carried forward as rapidly as possible, and the city will soon be traversed by a perfect network of roads.

The accompanying map shows strikingly the number of electric lines either already completed or in process of construction,



MAP OF CHICAGO, SHOWING ELECTRIC RAILWAYS.

while a short description of the work cannot fail to be of interest.

The North Chicago Electric Railway Company are building trolley lines on Milwaukee and Lincoln avenues, the latter running from Wrightwood to North 59th street, a distance of 7.68 miles, and the former from Armitage to Lawrence avenues, 10.21 miles. The Chicago Electric Transit Company have nearly completed a trolley line on Elston avenue from Chicago avenue to Montrose boulevard, the length of single track being 11.86 miles. The power house is situated on Roscoe boulevard and California avenue and has a total capacity of 8000 H. P. Four Siemens & Halske direct connected generators furnish the current.

The Chicago Electric Transit Co. in addition to the above mentioned line have some 28 miles of other lines projected, and work will probably be commenced on them next spring. Application

has also been made for a franchise on Belmont avenue from Milwaukee avenue to Elston avenue, another commencing at Western avenue and thence east on Belmont avenue to Robey street, and a third branch commencing at the west line of Ashland avenue and running east on Belmont avenue to Halsted street.

The North Chicago Street Railroad Company are trolleying every existing horse car line on the North Side and in almost every case have already commenced work. A part of the lines are expected to be in operation by the first of the year. The total length of these electric roads when completed will be 68 miles. The franchises sought by this company include lines in Rush street, between State street and the river; River street, between the river and South Water street; South Water street, between River street and State street; Erie street, between Rush street and Western avenue; Wisconsin street, between Lincoln Park and Cleveland avenue; Cleveland avenue, between Wisconsin street and Clybourn avenue; Clybourn avenue, between Cleveland avenue and Division street; Milton avenue, between Division street and Chicago avenue; Kingsbury avenue, between Chicago avenue and Erie street; Webster avenue, between the north branch of the Chicago river and Ward street; Ward street, between Belden and Webster avenues; Belden avenue, between Ward street and Lincoln Park.

The transformation of the horse car lines of the West Chicago Street Railroad Company into trolley lines is also progressing rapidly and when completed will contain 150 miles of track. This will be one of the largest networks of electric railways extant, and its lines will occupy the following streets: Wood street, between Blue Island avenue and Park street; Park street, between Wood and North Lincoln streets; North Lincoln street, between Park street and Webster avenue, and Webster avenue, between North Lincoln street and the north branch of the Chicago river.

Nearly all of the work has been contracted for and it is expected that early in the spring the entire system will be operated electrically. A modern power house is now being erected at the corner of Western avenue and Washington boulevard. The contract for boilers has been let to the Stirling Company, the engines will be furnished by Fraser & Chalmers, and the Siemens & Halske Company will install some large direct connected generators.

On the south side the Chicago City Railway Company are building trolley lines on the following streets: 26th, 31st, 35th, 39th, Root, 49th, 51st, 68th, 69th, 79th, Wentworth, Hanover, Wallace and Ashland. The line on 47th street has been in operation for some time and the Halsted street line has just been finished. Power for all of these will be supplied from their 53rd street power house where the Westinghouse Co. are now installing the necessary additional generators.

The Metropolitan elevated road will, of course, be operated by electricity and a power house is now in course of construction at Throop and Van Buren streets. This is expected to be ready for operation by January. The line at present extends from Jefferson street west to West 48th street, six miles, with a branch two and one half miles long. About twelve and one half miles will be completed by the end of this year and it is reported that some 25 miles additional will be constructed at once at an estimated cost of nearly \$20,000,000.

These proposed lines include a branch commencing at a point of the main line between the lake and the south branch of the river, running in a northerly and north-westerly direction to a point in the present northern city limits, between the lake and the north branch of the river; a branch from a point between the south branch of the river and Ashland avenue running easterly between Canal street and Ashland avenue to a point between 87th street and Tracy avenue, thence southwesterly to the village of Blue Island; a branch commencing between Division street and Fullerton avenue and running thence westerly between these two streets, through Chicago and the town of Cicero, to the western limits of the latter; and finally, a branch commencing between Lake and Division streets and running westerly between them to the western limits of Cicero. These new projects, it is said, will not be allowed to interfere with the rapid completion of the lines now under way. The company expect to have seventeen miles of lines in operation by January. The work so far has cost nearly \$10,000,000.

The new lines proposed will invade the territory of the north and west side elevated and surface roads under control of Mr. Yerkes.

The Lake Street Elevated Railroad Company is now operating 16½ miles of steam road on the west and north sides of the Chicago river, and it is rumored that this will also be changed to electric power within a short time.

NOTES ON ELECTRIC TRAMWAYS IN THE UNITED STATES AND CANADA.¹

BY H. D. WILKINSON.

During the author's visit to this country last year, as electrical engineer to the British Commission, he availed himself of the opportunity of studying street railway traction in the United States. After describing the general type of pole construction adopted, he gives the following as the details of costs: The entire track construction, including rails and wires, costs about \$7,000 per mile, and the car bodies, with motor trucks complete, cost about \$4,000 per car.² For a line of, say, 5 miles of track, with 15 cars, the power station, including building and machinery would cost about \$25,000, and real estate and car barns about \$15,000, bringing the total cost of equipment to \$185,000. The revenue per car mile is from 20 to 30 cents, and the total running expenses 14 to 16 cents, or, on the average, about 60 per cent. of revenue.

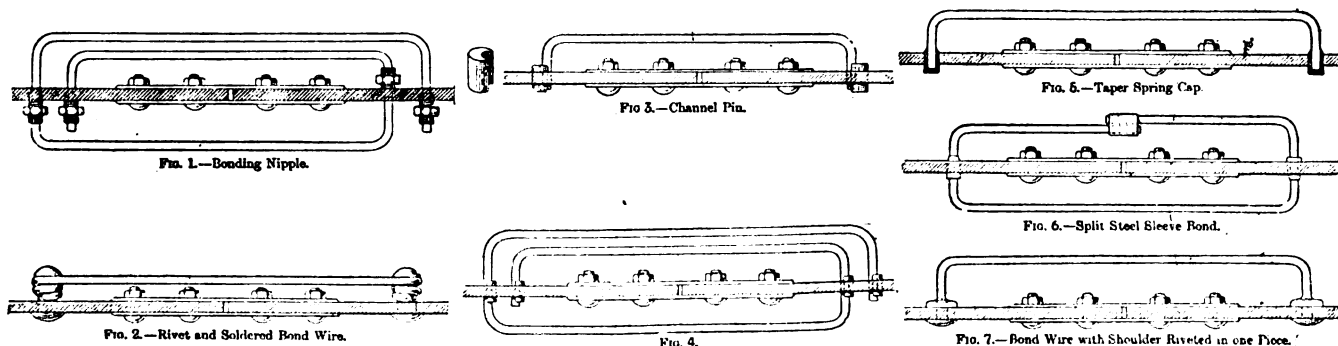
Coming to the questions now absorbing most attention among American street railway men, the author mentioned: 1. Better construction of road beds and tracks. 2. Better provision for the return circuit. 3. More uniform distribution of potential along the route.

As regards the first, practice in the western cities of America is chiefly with T, flat, or step rails, spiked down to wooden cross-ties or sleepers; but on the best lines and in most eastern cities the channelled girder rail as used in England has been adopted on account of smoother travel, less noise, and a flush road surface. The English construction of concrete foundation has been followed on some lines, using a 9 in. or 10 in. girder rail. The tendency now in the States is to put in very heavy girder rails (90 lb. or 100 lb.), spiked to wooden sleepers placed at about 2 ft. centres, which allows a good deal of spring in the track, and tends to loosen the bond contacts. Some 72 lb. channel girder rails I saw in progress of laying had grooves $1\frac{1}{2}$ in. wide by 1 in. deep. The height and base both measured 6 in. There was first an 8 in. foundation of

spring steel cap (Fig. 5), which is fitted on the end of the wire and driven into a hole in the web of the rail slightly less than its own external diameter. A similar bush joint, but formed as a sleeve or socket, has been in use some time on double bonds, as in the illustration, and promises well (Fig. 6). A considerable improvement consists in making the bond wire in one piece, with shoulders for riveting formed at each end on the wire itself. This device (shown in Fig. 7) is due to Mr. McTighe, of New York, and has been very largely used. The advantages of this plan are that clean, water-tight, and air-tight solid metallic joints are obtained, and that the bonds can be made of any size wire. Mr. McTighe prefers to use these in short lengths of 12 in. inside the fish-plates instead of the usual length of 30 in., thus saving 40 to 50 per cent. in bond resistance. The short bond cannot be fixed to the web of the rail on account of the fish-plates, but is either attached to the tread or the base, the latter being the better point of attachment, as the bonds are soon worn away when on the tread. This bond, however, sooner or latter becomes loose, owing to the difference in the coefficient of expansion of copper and steel, and, this being followed by galvanic action, the resistance, which at first is slight, rapidly increases at the joint. Some provision by which solder could be run in might add to the certainty of this joint, the ductility of the solder taking up the unequal expansion and contraction.

Some of the older lines in the States, laid before the value of good bonding was appreciated, show an enormous loss of voltage from this cause. The author was informed that on an old line in Richmond, Virginia, the bonding was done by No. 8 iron wires, and the same bonds used for a recent extension of $2\frac{1}{2}$ miles, with the result that of 500 volts put into the line not more than 210 appeared at the distant end. The matter was investigated in consequence of bad working, and good copper bonds substituted for the iron wire, with the result that the loss was reduced to 5 per cent.

Bond wires are subject to corrosion by electrolytic action,



TYPES OF RAILBONDS IN USE IN THE UNITED STATES.

concrete, upon which the sleepers (6 in. by 8 in.) were laid at 2 ft. 8 in. centres and then grouted in. Sand was then tamped round the base of the rails to the depth of 2 in., upon which the paving blocks were laid. The points and special work were of cast steel.

The question of returning the current direct to the power house with as little leakage and loss in voltage as possible, is one of the most important in street railway problems. Excluding for the moment insulated returns, the paths open for the return current from the cars to the power house are:—1. By the rails and return feeders; 2. By supplementary wires; 3. By the earth; 4. By metallic pipes and cables laid in the earth.

Referring to the means adopted for diminishing the resistance of the railway return leads the author describes a number of railway track bonds.

One form of bond joint (Fig. 1) consists of a steel nipple bored to fit the bond wire, and tapered and slotted at one end. This screws into the rail, and the nut screwed up tightens the wire in the nipple, and the nipple in the rail. This was introduced by Messrs. Stern and Silverman, of Philadelphia, and is used on the lines of the Electric Traction Company of that city, the bond wires being passed two or three times through the rail outside the fish-plates to obtain the necessary conductivity.

There are still many very imperfect bonds in use, such, for instance, as that with copper or iron rivets, and soldered bond wire (Fig. 2), of which I have a specimen here. In heading the rivet the soldered joint is frequently loosened, and the bond rendered useless. The channel pin bond (Fig. 3), of which I have a specimen here, is in very extensive use; but a great defect in this device is that it cannot be riveted or made to completely fill the hole, and corrosion takes place in the interstice. The channel pin is used for the double bonds on the Lynn and Boston line, as shown in the illustration (Fig. 4). Another bond is the taper

especially in alkali soils. The wires, consequently, become thinner and conduct badly, and some of the current is shunted round the joint to earth, thus increasing the corrosion. Again, when the wires get very thin they become heated and fuse, thus throwing extra load on other feeders. The author was informed that the action was prevented by painting the wires, or coating them with shellac and asphaltum. The section or number of bond wires has, of course, to be increased nearer the power station.

The conductivity of the return circuit has been increased on some lines by the use of a supplementary wire, which is usually of bare copper $\frac{3}{8}$ in. or $\frac{1}{2}$ in. diameter, laid along the centre of the track. Cross connections from all bond joints are made by copper wire twisted and soldered to the supplementary wire, and on double tracks the supplementary wires of each track are connected every 80 yards. The author saw new lines being laid with these wires in Chicago and Detroit, but he had also seen lines freshly opened up where the supplementary wires were considerably corroded, and was informed that their life was about two years. There were so many joints in the system, the wires used were so small, and were of such poor conductivity in comparison with a well-bonded rail, that the expedient appeared to him to be temporary and unreliable. In fact, he gathered that one of the chief uses of the wire was that its presence allayed to some extent the anxiety of the city authorities, otherwise harassed by water and gas pipe corrosion.

The result of the author's investigations and of his own experiments leads him to the belief that the earth offers a greater resistance than is generally imagined.

THE names of fifty-three celebrated sons of Massachusetts are to be inscribed around the dome of the new chamber of the House of Representatives. Among them are Morse, Franklin and Bell.

1. Abstract of a paper read before the London Institution of Electrical Engineers.

2. This figure has been considerably reduced within the last year.—Ed. E. E.

SELECTING RAPID TRANSIT ROUTES IN NEW YORK.

At the last meeting of the New York Rapid Transit Commission the question of a route for the East side was brought up and a report on the subject by Commission's engineer, Mr. W. B. Parsons, was read, as follows:

"According to the instructions contained in your resolution of two weeks ago, I have made a study of the extension of the east side route north of Forty-third street, where the plans provisionally adopted terminate, and herewith beg leave to submit my suggestions.

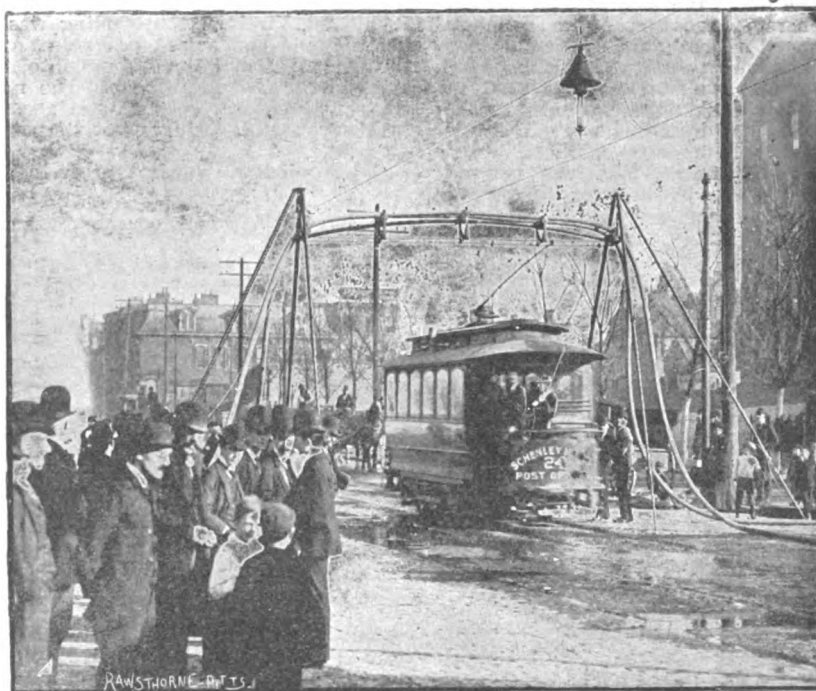
"I recommend to commence at a point at Fourth avenue, between Fortieth and Forty-first streets, where the present line diverges to the left, and continue in a straight line beneath the Grand Central Depot and the yard to a point about Forty-eighth street, there dividing the four-track system into two and carrying two tracks on each side of Fourth avenue, to the left and right respectively of the present Harlem River tunnel. Just north of Ninety-seventh street the tracks would emerge into an open cut and, by an ascending gradient, reach an elevation so as to give at least 20 feet in the clear above the Harlem tracks, thence by a steel elevated structure spanning the new steel structure now being erected by the Harlem River Railroad, thence continuing to the Harlem River, crossing the same to the north of the Harlem River Railroad bridge to Walton avenue, and continuing thence along

The extension ordinance was called in question by the city two years ago, and another company was chartered. The old company brought suit to enjoin the new company from using the streets, and set up the plea that its charter was perpetual and was conferred by the State upon certain conditions prescribed by the Common Council being complied with.

Ex-President Harrison made an argument in the case and the decision of Judge Woods, from which Judge Baker dissents, follows the line of Harrison's argument and holds the charter to be perpetual. The company, he says, received its right of existence from the statute and the ordinance of the Common Council merely defined how the privileges that were conferred should be exercised. The thirty-year limit placed upon the charter was void, because the Council had no authority to make such a limitation. The street railway is now owned by Murray Verner and H. S. McKee, of Pittsburgh, and other Eastern capitalists. Ex-President Harrison received a very large fee for acting as their counsel.

A NEW HOSE BRIDGE.

THE interruption to traffic frequently caused by fire hose lying across the tracks of street railways has made the demand for a practical hose bridge more and more felt since the introduction of the electric car. To meet this demand the Sullivan Hose Bridge



THE SULLIVAN HOSE BRIDGE.

the line surveyed and located by the previous Rapid Transit Commission, which line lies substantially parallel with and a short distance east of Jerome avenue.

"The officials of the New York Central Railroad have very kindly given me access to the plans of their present and proposed structures on Fourth avenue, sections of which accompany this report, from which you will see that the carrying out of an additional railroad on Fourth avenue conflicts slightly with their stations at Fifty-ninth street, Seventy-second street, and Eighty-sixth street, and also with their wide tunnel between Eighty-sixth and Ninety-sixth streets. Before detailed plans for your structure can be drawn an arrangement will have to be made with the New York Central Railroad Company looking to a modification of its structure at these points."

Mr. Parson exhibited and explained the drawings and tracings which he had made of this route. A committee was appointed to confer with the officers of the New York and Harlem Railroad Company and its lessees, with reference to questions which have arisen with regard to rapid transit routes, in so far as they seem to be affected by the railroads of that company.

TROLLEY FRANCHISE LITIGATION IN INDIANAPOLIS.

A decision has been handed down by the Federal Court in Indianapolis in the case of the Citizens' Street Railway Company against the city of Indianapolis. Twenty-three years ago the company obtained a charter from the Common Council for a period of twenty years. The time was afterwards extended.

Co., of Pittsburgh, Pa., will shortly bring out the hose bridge illustrated in the accompanying engraving.

The bridge is constructed of light iron or steel tubing, telescoping and folding in such a manner as to be easily stored and transported. While constructed of material sufficiently strong to carry a large weight, it is nevertheless light and easily handled.

The principle of the bridge is that of a swinging truss suspended from the ends of two adjustable and telescoping tripods to which it has been raised by block and tackle. The legs of the tripods telescope in as many parts as may be required, and can be raised to any height. The truss upon which the hose is raised is also constructed in such a manner that it can be extended to any length desired. It will carry any number of hose required and is easily lowered and raised again if desired for the purpose of taking off or adding additional lines.

The illustration shows the bridge in practical operation on the line of the Duquesne Traction Company at Pittsburgh on November 1, last, the trolley being lowered as the car slides under the bridge. The bridge can be handled by three men, even though they be inexperienced.

ELECTRIC RAILWAY EXTENSION AT NORTHAMPTON, MASS.

THE Northampton Electric Railway Company is to begin work at once on a five-mile extension to East Hampton, costing \$100,000. It will require 75,000 yards of earth to fill across the meadows where the route leaves the highway for two miles, and by so doing run absolutely straight and nearly level. Three iron bridges

will be required. It is expected to make the five-mile trip in 80 minutes, including also an additional half mile on the existing track in Main street, Northampton.

BIG TROLLEY DEAL IN TRENTON, N. J.

On Nov. 30 Chancellor McGill at Trenton, N. J., granted an injunction restraining the leasing of the Trenton Passenger Railway Company, Consolidated, to the Trenton Traction Company, a corporation existing only on paper, but which was to have been incorporated to-day after the lease was ratified.

The injunction was obtained by Samuel K. Wilson of Trenton, the largest single stockholder in the passenger railway company, who owns \$500,000 worth of its stock and is an indorser on \$40,000 of its paper, which has gone to protest, and on \$40,000 more that is not yet due. Mr. Wilson, in his application, declares that he knew nothing of the proposed deal until Nov. 25, and had no official notice until Nov. 27, when he received notifications of a directors' and stockholders' meeting to be held Nov. 30. Both notices were dated Nov. 21, but the envelope was postmarked Nov. 28. They declared the objects of the meetings to be the consideration of the proposed lease and an increase of the bonded indebtedness from \$1,000,000 to \$2,000,000. The lease proposed is for 999 years, in return for guaranteed dividends ranging from \$1.50 to \$4 a share for the first eight years and \$4 per share thereafter.

It is learned that the incorporators of the New Trenton Traction Company will include Thomas Barr of Newark, E. J. Moore of the Philadelphia Traction Company, Gen. William S. Stryker, Judge Robert S. Woodruff, Col. A. R. Kuser, John L. Kuser, and Hugh H. Hamill of Trenton. They say they control already a majority of the stock of the Passenger Railway Company and believe the lease will be ratified at a postponed meeting to be held next week. Men interested in the new company declare there is no intention to freeze out Mr. Wilson, and that his being kept in ignorance of the movement was due to the supposition that Col. Perrine, the Superintendent of the Passenger Company, represented the Wilson interest.

The Trenton street railways form an important link in the projected line from New York to Philadelphia, and their acquisition by the new corporation is generally believed to be in the interest of the New York and Philadelphia Traction Company.

BROOKLYN MOTOR MEN WANT MORE PAY.

THE motormen and other employees of the trolley companies in Brooklyn have renewed the movement for an increase in wages, and it has practically been decided that when the time comes for signing the contracts early next year a demand for an additional 25 cents a day will be made. All the railroad employees in Brooklyn are included in District Assembly 75, K. of L., and the delegates from the twenty-five local assemblies to it will have the ultimate decision as to whether the demand shall be made. A number of the local assemblies have already pronounced in favor of the increase. Last year the companies refused to accede to a similar demand, although a general tie-up on the lines was threatened. It is expected that there will be a very sharp controversy over the matter. The motor men are particularly emphatic in their determination to have their wages increased.

WEST END RAILWAY COMPANY ELECTION.

At a meeting of the Directors of the West End Street Railway Company of Boston held last Friday, the following officers were elected for the year ensuing: President, Samuel Little; Vice-President and Clerk, Prentiss Cummings; Treasurer, Joseph A. Goodspeed; General Manager, C. S. Sergeant; Auditor, H. L. Wilson; Purchasing Agent, H. F. Woods; General Solicitor, H. D. Hyde; Executive Committee, Samuel Little, Walter Hunnewell, Thomas Parsons, F. L. Higginson, H. D. Hyde.

WINTER TRACK-LAYING IN CLEVELAND, OHIO.

The Little Consolidated Street Railway Co. of Cleveland will at once proceed with the work of stretching its St. Clair st. line eastward. It is the intention to have the line completed by spring, ready for the summer travel. The cost, including the necessary equipment, is estimated at \$100,000. Supt. Mulhern, of the Little Consolidated, says that they are getting the consents without trouble, and propose to have a well-ballasted double-track line from Rocky River to Nottingham, 17 miles, as finely equipped as any road in the world.

ELECTRIC RAILWAY BOND ISSUE IN CHICAGO.

THE stockholders of the Chicago General Railway last week unanimously authorized an issue of \$10,000,000 bonds to be used in constructing lines for which the City Council was asked to pass ordinances recently. The company is busy securing right-of-way

signatures, and is meeting with satisfactory success in that direction. The officers express their entire confidence regarding the financial affairs, and say if they can obtain the ordinances at once they will go ahead with the construction. Another important action was taken at the meeting last week. The Chicago General Railway Company passed resolutions guaranteeing 6 per cent. dividends for five years on the \$500,000 stock of the West and South Town Street Railway Company and 12 per cent. dividend after five years. The property of the West and South Town Company is leased to the Chicago General Company.

THE MAHONING VALLEY ELECTRIC RAILWAY.

The Mahoning Valley Electric Railway Co., which proposes to connect Niles and Youngstown, has been incorporated. The projectors are R. G. Sykes, of Niles; C. F. Clapp, of Warren; A. A. Anderson and John E. McVey, of Youngstown; G. E. Harrick and Andrew Squire, of Cleveland. Excellent service is promised.

ELECTRIC LIGHTING AND POWER IN THE NEW MANHATTAN LIFE INSURANCE BUILDING.

THE new Manhattan Life Insurance Building on lower Broadway, the tallest building thus far constructed in New York City, is equipped with the latest electrical appliances and we reproduce from our contemporary, *The Engineering Review*, a description of the plant.

It is not proposed to use gas generally for lighting. Arrangements have been made for its use for emergency lights placed in the different hallways and a few lights in the pipe cellar. Electric light, maintained by current furnished by the dynamos in the building, is furnished to every office and room. In case of emergency, or when the boilers and engines are not in operation, the throwing of a switch will connect the building with the Edison Illuminating Company's street mains. The building is wired on the three-wire system for 8,236 sixteen candle-power lamps arranged on nine circuits. The generating plant works at a difference of potential at the terminals of 220 volts. In the main entrance there is provided a circuit to supply four 50 candle-power lamps operated from a switch placed at a convenient point inside the building. The main ceiling is arranged in a series of domes, and around each of these domes is arranged 32 lamps, placed about 1 foot apart and arranged in two circuits for each dome. The offices are grouped in two systems, comprising first the inner or court rooms which require light during the day, and second, the outer rooms facing on Broadway and on New Street that only require light late in the afternoon, except on very dark days, when the large machine will be in operation. The rotunda in the centre of the sixth floor is lighted by eight clusters with eight lights in each cluster. Two clusters are placed on each side of the rotunda over the columns. The ceiling lights immediately in front of the elevator in the rotunda are controlled by switches, but the cages for clerks in the rotunda have standard desk lights. There are about 200 lights in the general room to accommodate about 50 clerks with a two-lamp standard each. The general illumination of the room is from the ceiling and is controlled by switches. In the three-wire system of conductors used the neutral wire has a capacity equal to the combined capacity of the outside conductors. The wiring is divided into feeders, mains and branches. The feeders are run direct from the main switchboard in the dynamo-room to the feeding centre, where they connect with the mains which supply through main double-pole cut-outs to switches, one for offices lighted from the court and one for light offices, in cabinets located in toilet-rooms on each floor. From these points mains are carried in the chambers which are provided in the corridors. With all safety devices open the insulation resistance of any single section of wiring is not less than 300,000 ohms. The combined insulation resistance when all sections are connected is not less than 150,000 ohms. All wires are protected by air spaces and entirely isolated from metallic contact or inflammable substances. The insulation is as nearly as possible fireproof and water-proof.

Connections for a 220-volt current are made from the dynamo switchboard to the several motors required for the elevator service as follows: 1. One 18 horse-power motor and pump to be used in connection with one of the main hydraulic elevators for temporary service when the steam plant is shut down. 2. One 8½ horse-power motor to be used in connection with a direct electric elevator, which will travel from the sixth floor to the mezzanine floor. 3. One 8½ horse power motor to be used in connection with the tower electric elevator, which will travel from the seventeenth floor to the dining-room floor. Sufficient margin is allowed in the electric plant for the addition of another machine with an 8½ horse-power motor at some future time. The wiring is so arranged at the switchboard that the motors may be run from the building's plant or from the central station system. The electric motor plant comprises three standard "ironclad" multipolar, slow-speed 50-kilowatt dynamos for electric lighting coupled direct to three Armington & Sims vertical engines, one 25-kilowatt

slow-speed multipolar dynamo, wound for a pressure of 220 volts and connected direct to an Armington & Sims vertical engine. This is used for power work independent of the lighting plants and is connected in such a manner that by the throwing of a switch the elevator motors and pumps may be connected to the street service. There are also three motors driving the exhaust ventilation fans. Opposite each office mains run through double-pole three-wire main branch blocks and three-wire tap circuits firmly screwed to the face of the cut-outs and carried in tubes or ferrules through fireproof partitions into each office and then carried around the office close to the ceiling. Two brass conduit tubes and two wire circuits are run down for each outlet. A switch is located in a pocket provided for the branch cut-out for each office. Every switch has a cut-out or safety catch to protect it and another on the circuit side to protect the circuit. In no case is more than five amperes allowed on any tap circuit. All mains are inclosed in brass-covered conduit tubes firmly secured in the corridor chamber. The insulation is not less than three thirty-seconds of an inch thick. The capacity of the wiring was calculated on the two-wire system and on the basis of 110 volts and one-half ampere per 16 candle-power lamp. The maximum loss in any circuit from switchboard to farthest lamp does not exceed 5 per cent., and the maximum drop in any branch circuit does not exceed 2 per cent. The variation in pressure between lamps on the same main does not exceed 1 per cent. In all calculations for wiring the feeders and branch wires are calculated for full connected load and the mains for two-thirds of the full connected load. The sizes of wire used are calculated for potential drop and heating so that there shall not be a rise of temperature in any conductor carrying full load of over 10° Cent. No smaller wire than 14 Brown & Sharpe is used nor any single wire larger than 8 Brown & Sharpe. When greater conducting capacity is required, stranded wire is used. All wires which pass through floors, or that rest against any metal-work, are protected by a tubing of hard insulating material, extending 1 inch in each direction beyond such floor or metal-work. All wire is run in molding or brass-covered tubing. Where conduit tubing is used it is brass covered, and when used in localities where dampness is likely to exist it is of sufficient size to admit of a ferrule being inserted inside of tube and the next length entered over and into a metal connector, compressed on and painted with water-proof compound. Not more than one wire is run in one tube. Conduits are installed so as to be gas and water tight, and made so as to permit any wire to be readily drawn in or out if required. Powdered soapstone was blown through the tubes before the wires were inserted. No tube is less than three-eighths inch inside diameter.

LETTERS TO THE EDITOR.

WATER POWER GOVERNORS.

We have noticed in THE ELECTRICAL ENGINEER of November 21 an inquiry for a water power governor. As Mr. Holmes seems to be situated the same as we are we take the liberty of writing our experience in the line in which his inquiry runs. We are running a motor circuit by water power, and although our variations of load do not begin to be what they would be on a street railway circuit, yet the means we have adopted to keep our potential constant are perfectly practical for more severe conditions. We think that the idea of using an artificial load to throw on and off in opposition to the variations on the line is about the only practical one where water is to be used as a source of power. Although we have a sensitive water wheel governor we do not pretend to use it, as it is entirely too slow to keep up with variations on a motor circuit.

Our regulator consists of two parts—a series of iron wire resistance coils and an automatic regulator for sending current through more or less of these coils. The coils are simply iron wire closely wound and then stretched out until each convolution is separate from the adjoining ones and hung on a wooden frame. Putting the wires on a wooden frame is not strictly good practice as the frame is not fire proof, but as the wires at no time become more than warm to the hand we thought we would build this one that way as it is a great deal more difficult to put the wires on an iron frame. The regulator is composed of a flat commutator, and a sliding brush. The commutator is made of 60 sections, each one being a piece of No. 16 sheet iron 3 x 1½ inches. These 60 sections are insulated from each other and then bound together in a block 3 x 1½ inches on the end and 7 inches long. The brush is made to slide along on one of the 3 x 7 inch faces of the block and thus to come in successive contact with the edge of each of the 60 sections. Sixty connections are made between the commutator block and the resistance coil so that the potential between any two adjoining sections of the commutator block is small enough to keep the sparking down to a very small amount. Our regulator and coils handle 23 amperes at 250 volts. Of course to adapt it to 200 amperes and 500 volts it would be simply a question of size and more sections. The manner in which we cause the brush to travel across the commutator automatically, is as follows:

The brush consists of a piece of brass about one inch square and three inches long held on two rods which slides lengthwise of the commutator, the brush being at right angles to the rods and having its length corresponding to the three inch width of the face of the commutator. Along the side of the brush next to the commutator there are drilled a series of ¼ inch holes and in these are set little pencils of carbon or copper pressed against the face of the commutator by a small spiral spring in the bottom of each of the holes. The brush is similar to the end-on carbon brushes used on some motors where pencils of carbon are pressed on to the commutator by spiral springs. The sliding rods travel in bearings supported from the wall. One of the rods has teeth milled across it, and on this rod a carriage is made to continually slide back and forward with a stroke of ¼ inch which is a little more than the distance from one tooth to another, on the rack. On the carriage there are two pawls made to engage the rack in opposite directions, and each pawl has a magnet to pull it into contact with the rack. These magnets are connected by three wires with a potential indicator, which energizes one or the other of them, according to whether the potential is high or low, thus pulling down the corresponding pawl, which in turn causes the brush to shift across the commutator, and thus cut in or out some of the resistance coil. For street railway work the potential indicator would probably need to be compound wound so that as the load increase on the line the potential would rise, similarly to any over compounded street railway plant. The carriage is made to continually vibrate through its ¼ inch stroke by a small crank on a shaft which is belted to the line shaft. The small shaft has two pulleys so that in case of violent fluctuations of load we can make the carriage run twice as fast as ordinarily. The ordinary speed is about 50 strokes per minute. This entire apparatus works very satisfactorily and we would hardly know how to get along without it. We have but one fault to find with it, and that is that the continually vibrating motion tends to work everything loose. We are now building one to work on a continuously rotating motion which we think will obviate the above objection and also give us an almost unlimited speed, which would be quite desirable in street railway work.

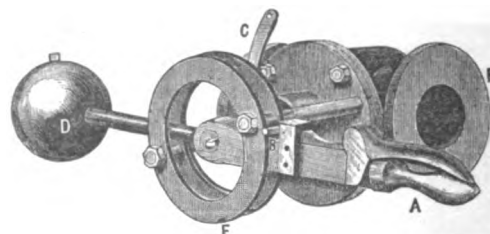
We trust that this will be of some use to your correspondent and that others will write on the same subject. There are many water powers that could be used to great advantage for street railway work if the power could only be regulated. If at any place it should be desirable to save some of the water that the above device would waste a quick working water wheel governor might be used in connection with the regulator. We have never tried this combination.

WILEY & WARNER ELECTRIC CO.

BELLOIT, WIS.

FLY-WHEEL ACCIDENTS.

The letter of "J. S." on the prevention of fly wheel accidents in your issue of November 14 leads me to call your attention to an automatic throttle valve, shown in the accompanying illustration, the practicability of which we have demonstrated by several years use. It is operated either by hand or from any desired point by a cord connected with lever C, which throws the trip, and instantly shuts off the steam. Should the engineer be away from his post, a whistle is so connected, as to be sounded at the same time, thereby enabling him to return, even before the machinery has stopped, and lose no time in starting up. The throttle as shown



AUTOMATIC THROTTLE VALVE FOR PREVENTING FLY-WHEEL ACCIDENTS.

in the engraving is closed. By drawing down the lever A and allowing the dog B to catch in the nick E the throttle is thrown wide open. The engine may be run under check and closed from the same position as well as when under full headway.

The valve is also operated entirely automatically by means of a weight connected to the cord, arranged so as to be over-balanced by increased centrifugence. It is superior to any motor device in so far as it acts instantaneously, and is absolutely independent of belts or other connections which are affected, and whose fallibilities are increased, by the increased centrifugence.

I should be pleased to hear from J. S.

J. D. C.

ASHVILLE, N. C., Nov. 23, 1894.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS
ISSUED NOVEMBER 20, 1894.

Conductors, Conduits and Insulators:—

Manufacture of Electric Conductors, J. Robinson, Philadelphia, Pa., 529,411. Filed Feb. 16, 1894.

Relates to means of applying fibrous material to an insulated wire and subjecting it to a bath of insulating material.

Insulated Electric Conductor, J. Robinson, Philadelphia, Pa., 529,412. Filed Feb. 17, 1894.

Similar to No. 529,411.

Manufacture of Electric Conductors, J. Robinson, Pittsburg, Pa., 529,413. Filed Feb. 6, 1894.

Similar to No. 529,411.

Electric Circuit, J. W. Marsh, Pittsburg, Pa., 529,559. Filed Apr. 10, 1894.

Consists of a pair of spirally twisted conductors separated by a water proof insulation, and also by a non-water proof insulation of lower specific inductive capacity, the former consisting of a covering of one conductor and the latter of a covering of the other conductor.

Dynamoes and Motors:—

Electric Fan Motor, F. X. Hofbauer, Newark, N. J., 529,385. Filed Aug. 1, 1894.

Audible Synchronism Indicator, R. D. Mershon, Pittsburg, Pa., 529,398. Filed Apr. 27, 1894.

The invention depends upon the opposing effect of two magnetic poles upon a diaphragm; the poles being created by currents generated by the *m. m. f.*'s across the terminals of the machine to be synchronized.

Audible Synchronism Indicator, R. D. Mershon, Pittsburg, Pa., 529,399. Filed Apr. 27, 1894.

Similar to No. 529,398.

Armature Core, J. J. Wood, Fort Wayne, Ind., 529,437. Filed Aug. 21, 1894.

Claim 1 follows:

A laminated armature core built up of alternated segmental blanks having hooks for overhanging the fastening bolts of the spider, the hooks of alternate laminas embracing said bolts from opposite sides.

Method of and Means for Synchronizing Alternating Current Motors or Generators, H. N. Potter, Allegheny, Pa., 529,461. Filed May 3, 1894.

The invention consists in producing two magnetic circuits having a common motor pole and subjecting a single body capable of vibration by magnetism to the influence of said motor power.

Apparatus for Generating Electricity for Lighting Railway Cars, T. A. Murray, Boston, Mass., 529,563. Filed May 3, 1894.

Employs a generator below the car body and having its armature driven from the track independently of the car axle.

Continuous Current Dynamo Electric Machine, M. Hutin and M. Leblanc, Paris, France, 529,650. Filed Feb. 12, 1894.

A generator provided with one or more circuits of low resistance closed upon themselves and threading through the polar extensions of the field magnets.

Lamps and Apparatuses:—

Electric Incandescent Lamp, E. Thomson, Swampscott, Mass. and E. W. Rice, Jr., Lynn, Mass., 529,420. Filed Feb. 8, 1892.

A lamp adapted especially to three-phase systems, and provided with mechanism by which its brilliancy may be increased and decreased at will.

Electric Light Fixture, J. R. Konetahny, Brooklyn, N. Y., 529,654. Filed Feb. 21, 1894.

Measurement:—

Electrical Measuring Instrument for Switchboards, J. Van Vleck, New York, 529,433. Filed April 14, 1891.

The invention consists in combining on one board a series of measuring instruments each having its pointer at its edge instead of upon its face and having all the edges exposed to view.

Electrical Measuring Instrument, E. Weston, Newark, N. J., 529,431. Filed Oct. 3, 1892.

The invention consists in disposing a coil arranged on one arm of the lever and counterbalanced in the field of force of a fixed parallel coil, and in opposing the movement of the lever by a spring which will weigh the force due to the mutual reaction of the fields of the two coils.

Electrical Measuring Instrument, E. Weston, Newark, N. J., 529,435. Filed June 21, 1894.

Relates especially to the construction of the case and scale of the instrument.

Miscellaneous:—

Electromagnetic Apparatus, S. D. Field, Stockbridge, Mass., 529,373. Filed July 24, 1894.

Employs a polarized induction coil having both poles of the inducing medium enclosed within the primary and placed outside of the secondary circuit.

Combination Gas and Electric Light Fixture, G. A. Loeben, Philadelphia, Pa., 529,461. Filed June 7, 1894.

Railways and Appliances:—

Contact Device for Overhead Electric Railways, J. L. Blackwell, New York, 529,354. Filed Sept. 15, 1893.

Employs an intermediate contact device bearing on the under side of the trolley wire, consisting of a rod having a transversely traveling movement and provided at its upper end with the contact device.

Underground Electric Railway, H. B. Nichols & F. H. Lincoln, Philadelphia, Pa., 529,406. Filed June 13, 1894.

Employs a conduit adapted to the reception and support of supply or feeder wire and main conductors of an electric railway.

Trolley Stand, F. N. Kelsey, New Haven, Conn., 529,552. Filed Aug. 29, 1894.

Section Insulator, A. Hennefeld, C. Dehner & C. H. Van Ness, Colorado Springs, Colo., 529,616. Filed Apr. 19, 1894.

Consists of a curved bar of insulating material provided with metallic tips and a perforated insulating bar with clamps for holding the trolley wire.

Gearless Electric Locomotive, C. J. Van Depoele, Lynn, Mass., Dec'd. C. A. Coffin & A. Wahl, Administrators, 529,071. Filed June 3, 1891.

Claim 1 follows: An electric motor for cars mounted upon a sleeve surrounding the axle and sustained by springs secured to the wheels.

Switches and Out-Outs:—

Electric Switch or Out Out, J. C. Cassidy, East Orange, N. J., 529,363. Filed Aug. 11, 1894.

Provides means by which any one or all of the series of lamps may be turned on or off by one turn of the switch.

Switching Apparatus for Incandescent Electric Lamps, C. E. Scribner, Chicago, Ill., 529,532. Filed April 22, 1893.

Provides for turning off incandescent lamps from two different points.

Switch, F. B. Badt, Chicago, Ill., 529,573. Filed Oct. 14, 1893.

A mercury switch in which the connection is made and broken in an air-tight chamber.

Electric Switch and Out-Out, J. C. Cassidy, East Orange, N. J., 529,595. Filed Sept. 24, 1894.

Similar to No. 529,363.

Telegraph:—

Printing Telegraph, B. A. Flake, United States Navy, 529,484. Filed Oct. 13, 1888.

Printing Telegraph, G. A. Scott, London, Eng., 529,630. Filed Sept. 6, 1887.

Telephones and Apparatus:—

Multiple Switchboard System, C. E. Scribner, Chicago, Ill., 529,421. Filed May 1, 1890.

Employs a cord switch consisting of a frame having a socket for one of the plugs, a pair of springs in a branch through a telephone and battery to ground and a plunger provided with an arm and contact springs, the latter operated by forcing down the plunger.

Telephone System, J. I. Sabin, San Francisco, Cal., 529,465. Filed April 14, 1894.

Provides means whereby the sub-station apparatus of two or more subscribers may be connected with a single telephone line, the apparatus being under control of the operator at the central station.

Antispeaking Mouthpiece for Telephones, R. N. Denison and F. M. Geary, Brooklyn, N. Y., 529,609. Filed April 25, 1894.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS
ISSUED NOVEMBER 27, 1894.

Alarms and Signals:—

Electric Signal for Railway Crossings, D. W. Smith, St. Louis, Mo., 529,759. Filed Sept. 10, 1894.

Claim 2 follows:—

The combination, with a crossing-clamp, of a supply conductor, an electric lamp mounted upon and supported by said clamp, and a supply conductor for said lamp.

Railroad Signal, C. Selden and F. P. J. Patenall, Baltimore, Md., 529,811. Filed Dec. 18, 1893.

An automatic electric block signal system for steam railways.

Railroad Signal, C. Selden, Baltimore, Md., 529,812. Filed Jan. 4, 1894.

An automatic electric block signal system for steam railways.

Signal for Cable Railways, G. F. Klaffky and F. Faltinowsky, New York, 529,630. Filed May 8, 1894.

Provides means whereby a car whose grip has become entangled in a broken strand of the cable will automatically signal to the power house to stop the cable.

Electrical Recording Device for Safes, R. A. Newlyn, Cincinnati, Ohio, 529,938. Filed April 23, 1894.

Electrical Danger Signaling System, W. A. Phillips, United States Army, 529,949. Filed May 29, 1893.

An automatic block signal system for steam railways.

Speed Indicator and Alarm, G. A. Thompson and J. F. Schmadeke, Brooklyn, N. Y., 529,975. Filed April 27, 1894.

A centrifugal electrical alarm adapted for use on cars.

Electric Signal Apparatus, H. E. Walter, Richfield Springs, N. Y., 529,984. Filed Jan. 9, 1893.

A signal system adapted equally to hotel annunciators and police patrol systems.

Electric Signaling Apparatus, H. E. Walter, Richfield Springs, N. Y., 529,985. Filed Feb. 23, 1894.

Similar to No. 529,984.

Electric Signaling Apparatus, H. E. Walter, Richfield, Springs, N. Y., 529,986. Filed Apr. 23, 1894.

Similar to No. 529,984.

Dynamoes and Motors:—

Commutator Brush for Dynamoes, G. Forbes, London, Eng., 529,784. Filed Aug. 8, 1894.

A brush consisting of conducting fibrous or textile material.

Alternating Current Generator, J. F. Kelly, Pittsfield, Mass., 529,918. Filed Aug. 18, 1894.

Employs a field magnet and an armature having opposing faces one of which bears to the other the relation expressed by the formula of an inverse sinusoidal curve.

Conductor Coil for Armatures and Field Magnets and Methods of Making Same, E. W. Alexander & H. Groswith, Philadelphia, Pa., 529,968. Filed Sept. 22, 1893.

The method consists in winding on the conductor a layer at a time with convolutions separated from one another and filling the spaces with enamel.

Electric Elevator Motor, W. C. Fletcher, St. Louis, Mo., 529,032. Filed June 14, 1894.

Employs an independent multiple winding on the armature in combination with a sectional series field to produce C. E. M. F. which will equal the normal when the motor has acquired but a slow speed at starting.

Galvanic and Thermo-Electric Batteries:—

Sectional Thermo-Electric Generator, H. B. Cox, Hartford, Conn., 529,710. Filed Jan. 31, 1894.

Claim 1 follows:—

A thermo electric generator built up of interchangeable sections each section exteriorly coated and complete within itself.

Heating:—

Electric Robe Towel, etc., for Heating, H. G. O'Neill, Boston, Mass., 529,053. Filed Apr. 9, 1894.

A fabric provided with a flexible resistance having water proof and fire proof coatings and adapted to connect with the conductors of an electric circuit.

Metal Working:—

Box or Furnace for Electric Heating Apparatus, C. L. Coffin, Detroit, Mich., 529,019. Filed Feb. 9, 1893.

Consists of a box formed of refractory slabs and lined with carbon slabs.

Apparatus for Welding Rings, C. L. Coffin, Detroit, Mich., 529,030. Filed Feb. 12, 1894.

Method of Electrically Heating Metal, C. L. Coffin, Detroit, Mich., 529,031. Filed July 10, 1894.

Claim 1 follows:—

The herein described method of electrically heating metal consisting in bringing the metal in circuit with a liquid electrode containing a substance more volatile or vaporizable than water.

Miscellaneous:—

Ornament for Lightning-Rods, C. F. Keys, Washington, D. C., 529,866. Filed Mch. 23, 1894.
Keyboard Attachment for Musical Instruments, J. D. Case, Plainfield, N. J., 529,895. Filed Mch. 30, 1893.

Railways and Appliances:—

Means for Supporting Motors in Electric Locomotives, W. S. Adams, Philadelphia, Pa., 529,688. Filed Nov. 9, 1893.

Employs a frame by means of which the axle is relieved of about four-fifths of the weight of the motor.

Closed Conduit Electric Railway, O. G. Burke, Brooklyn, N. Y., 529,704. Filed Feb. 10, 1894.

Employs a conduit having upper and lower compartments the lower of which contains circuit controlling levers establishing connections between the rails and supply conductors and actuated by an arm attached to the car.

Thermo Electric Generator, H. B. Cox, Hartford, Conn., 529,711. Filed Jan. 31, 1894.

Employs a stationary body of liquid for the purpose of heating the inner face of the pile.

Closed Conduit for Electric Railways, F. L. King, Chicago, Ill., 529,797. Filed Jan. 15, 1894.

Claim 1 follows:—
 In a conduit for inclosing the conductors of electric railways, a support having journals and a cover removably pivoted to said journals.

Conduit Electric Railway, L. O. Pressley, San Francisco, Cal., 529,836. Filed Feb. 6, 1894.

Has for its object to convey current to a completely insulated conductor, to transmit it successively to short sections of the trolley rails during the passage of the car, and to cut it off the instant the car has passed.

Trolley Wire Support and Coupling, A. P. Gould, Canton, Ohio, 529,908. Filed Mch. 7, 1894.

Consists of a body portion having at its lower edge a projection for holding the wire, and a cap held in position by binding screws.

Supply System for Electric Railways, Z. Foster, Chicago, Ill., 530,063. Filed Mch. 7, 1894.

Employs an air tight casing enclosing the free ends of the branch wires, and spring retracting pins adapted to come in contact with the branch wire when the car passes.

Switches and Cut-Outs:—

Rotatable Electric Contactor, J. W. Curry, Cairo, Ill., 530,598. Filed July 9, 1894.

Electrical Contact Mechanism, J. F. Blake, New Haven, Conn., 530,004. Filed June 21, 1894.

Plug and Receptacle for Electrical Purposes, D. J. Cartwright, Boston, Mass., 530,066. Filed Jan. 24, 1894.

Telephones and Apparatus:—

Telephone, A. Stromberg and A. Carlson, Chicago, Ill., 529,818. Filed Oct. 9, 1894.

Relates especially to means for readily adjusting the diaphragm with regard to the magnet poles.

Telephone Switch, E. S. Combs, Rochester, N. Y., 529,826. Filed Oct. 9, 1894.

Relates especially to a specified construction of a switch hook.

Signaling Apparatus for Telephone Exchange Systems, J. H. Cary, Malden, Mass., 529,894. Filed March 17, 1894.

Provides means for calling any one sub-station independently of all others on the line, by the employment of magneto currents varying in quality, direction or polarity.

Switchboard, L. A. Berthon, Paris, France, 529,999. Filed Oct. 17, 1894.

The invention consists in rendering the bands of spring jacks movable and connecting them to bands arranged in the frame work of the switchboard.

Trade Notes and Novelties AND MECHANICAL DEPARTMENT.

AWARDS FOR SIGNAL OFFICE SUPPLIES—WAR DEPARTMENT.

The following awards have been made for furnishing the Signal Office, War Department, with telegraph and signal supplies:

James Clendenin, Baltimore, Md., 75 boxes bluestone in 50 pound boxes, \$1.70 and \$1.74½ per box.

Morrison, Plummer & Co., Chicago, Ill., 2,700 pounds bluestone, 8½ cents per pound; 8,000 pounds sulphuric acid, \$1.15 per 100 pounds.

The E. S. Greeley Co., New York, N. Y., 50 carbons and prisms, 50 cents each; 25 pounds mercury, 58 cents per pound; 50 Leclanche cells, 69 cents each.

Kennedy & DuPerow, Washington, D. C., 200 battery connectors, 6 cents each; 50 Leclanche zincs, 8 cents each.

Royce & Marean, Washington, D. C., 6 hydrometers, 25 cents each; 800 battery jars, 10 cents each; 50 pounds office wire, 21 cents per pound; 1,000 battery zincs, 11 and 11½ cents each.

Excelsior Manufacturing Co., St. Louis, Mo., 6,000 pounds iron filings, 50 cents per 100 pounds.

GREAT WESTERN MFG. CO. IN TROUBLE.

On Friday, November 30, the Great Western Mfg. Co., Chicago, gave a bill of sale of their premises and contents, to the First National Bank of that city for a debt said to amount to nearly \$100,000. On the following day the company confessed judgment for \$15,000 in favor of Mary J. Lamb for borrowed money. The company was placed in the hands of a receiver on Saturday, Dec. 1. It is stated by friends of the company that a reorganization is likely to be effected that will place the business on a solid footing.

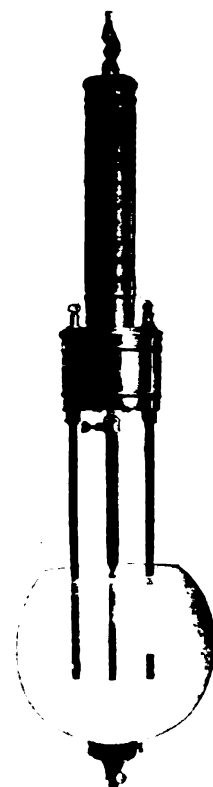
THE ELECTRIC APPLIANCE COMPANY are having a run on their "Acme Expanding Wire Guard." This is a specialty of which the Electric Appliance Company are the exclusive manufacturers. It automatically clamps the socket without the use of a holder.

THE NEW HELIOS DIRECT CURRENT ARC LAMP.

THE Helios Electric Co., of Philadelphia, have brought out the new direct current arc lamp shown in the accompanying illustration. It was designed by Mr. Thomas Spencer, of the Helios company, and is of novel design. It is claimed that these lamps will not see-saw, and the company guarantees that when they are run two in series on a 110 volt circuit, or four in series on a 220 volt circuit, one lamp will not "rob" current from any other, and all will be perfectly noiseless in operation.

The company has also just introduced a new alternating street lamp designed for use on a 33-volt transformer circuit. A resistance and cut-out are contained in a case at the top of the lamp frame. This was also designed by Mr. Spencer.

BALTIMORE, MD.—A certificate of incorporation has been filed of the North American Interior Telephone Co. of Baltimore City, with Messrs. Frederick W. Schultz, J. Kemp Bartlett, Jr., Seneca P. Broomal, Charles C. Hughes and Thomas R. Brimmer incorporators and directors. The corporation proposes to manufacture telephones, telephone appliances, electric switches and other electrical machinery and supplies, and to construct telegraph and telephone lines, etc. The capital stock is fixed at \$60,000 divided into 600 shares of the par value of \$100 each.



New Helios Arc Lamp.

WESTERN UNION BURNED OUT IN BOSTON.

A fire on the night of Nov. 27 destroyed the top of the Western Union building, 109 State street, Boston, cutting off all connection from the main office, with the newspapers and the branch offices in the city, as well as all outside the city. There were forty operators on the fifth floor, and they made a rush for the street down the narrow stairs, but all got out without injury. Great inconvenience was caused the newspapers by the fire.

NEW YORK NOTES.

THE BROOKLYN EDISON CO. shows a gain in gross earnings for October of nearly \$12,000 over the same month in 1893, and a gain of \$6,000 in net earnings.

CENTURY WIRE FOR JERSEY CITY.—Mr. C. Newton, the New York representative of the Campbell Electrical Supply Co. of Boston, has secured an order for 20 miles of "Century" wire for the Jersey City fire alarm system. The struggle for the order was a sharp and lively one, but Mr. Newton is pleased that his persistence and the merits of the wire have thus won a large portion of the present contract.

THE BIDDLE RAILWAY CAR ELECTRIC LIGHTING CO. has been organized by Mr. Wm. Biddle the inventor of the system of electric lighting described in our issue of June 13, 1894, for the purpose of placing on the market his latest patents covering this system of car lighting. Mr. Biddle severed his connection with the American Railway Electric Light Co. last August. The offices of the new company are at 108 Fulton street New York city.

THE BERLIN IRON BRIDGE CO. will furnish the new power station for The United Electric Light & Power Co., on East 28th St., New York city. The power house is 100 ft. wide and 200 ft. long; the engine room is 100 ft. wide and 80 ft. long, and the boiler room is 56 ft. wide and 100 ft. long, the whole covered with The Berlin Iron Bridge Company's patent anti-condensation corrugated iron roof covering. The coal pockets in the boiler room have a capacity of 3,000 tons.

THE GOULDS MFG. CO. of Seneca Falls, N. Y., inform us that they have an edition in press of their pamphlet on power pumps for every service. This book will be 6½" high by 7½" wide, 96 pages, handsomely bound. It will be devoted entirely to "Efficient Power Pumps and Their Applications." In connection with these applications they show a large number of sketches, illustrating pumps in operation for different service, etc., etc. The book will be replete with new goods and contain much information of value to engineers and pump men generally. They are anxious to place this book with all interested parties and will be pleased to receive applications to add to their mailing lists. The book will be ready for distribution next month.

ONE MONTH WITH THE MATHER MACHINES.

The Mather Electric Company of Manchester, Conn., report the following sales of apparatus for the month of October. The Company now has orders ahead for three months and is operating its entire plant overtime until 10 o'clock every night:

Hartford & West Hfd. St. Ry. Co., Hartford, Ct. (3d order), 180 k. w. 500v. generator; Hartford & West Hfd. St. Ry. Co., Hartford, Ct. (3d order), 180 k. w. 500v. generator; Bloomington City Railway Co., Bloomington, Ill., 100 k. w. 500v. generator; Amory Mfg. Co., Manchester, N. H., 80 k. w. 120v. generator; Charles R. Lewis Clothing Mfg. Co., Belleville, Ill., 30 k. w. 120v. generator; Stamford Hotel, Chicago, Ill., 45 k. w. 120v. generator; John Jermyn, Scranton, Pa., 100 k. w. 300v. generator; Southwest Va. Improvement Co., Pocahontas, Va., 60 k. w. 220v. generator; Somers Fuel Co., Belle Vernon, Ohio, 60 k. w. 320v. generator; J. Holt Gates, Chicago, Ill., 60 k. w. 220v. generator; J. Holt Gates, Chicago, Ill., 30 k. w. 120v. generator; J. Holt Gates, Chicago, Ill., 100 k. w. 500v. generator; Burtis & Howard, Minneapolis, Minn., 11 k. w. 220v. dynamo; Stanley Electric Co., Pittsfield, Mass., 2 k. w. Manchester exciter; Jones & Lamson Machine Co., Springfield, Vt., 350 light dynamo; Warren Shaw & Co., South Peabody, Mass., 350 light dynamo; Lewis Anderson & Co., Skowhegan, Me., 600 light dynamo; George Pappert Mfg. Co., No. Milwaukee, Wis., 150 light dynamo; H. B. Coho, New York City, 450 light dynamo; Cobb, Bates & Yexra, Fall River, Mass., 600 light dynamo; Chambers Electric Light & Power Co., Truro, N. S. (6th order), 600 light dynamo; Ohio State University, Columbus, Ohio (2d order), 15 H. P. Manchester motor; Sheriff of Hampden County, Springfield, Mass., 5 H. P. Manchester motor; Aetna, Electric Works, Hartford, Conn., 6 H. P. Manchester motor; Charles R. Lewis Clothing Mfg. Co., Belleville, Ill., 5 H. P. Manchester motor; Harry S. Anderson, Springfield, Mass., 600 ampere special dynamo.

The Mather Co. report also shipments consisting of further October orders, and former orders:—

Bartram Hotel, Phila., Pa., 2 45 k. w. direct connected machines; New Pittsburgh Coal Co., New Pittsburgh, Ohio, 60 k. w. 220v. generator; Morris Coal Co., Sand Run, Ohio, 60 k. w. 220v. generator; Henry R. Worthington & Co., Brooklyn, N. Y., 45 H. P. 220v. generator; Jones Bros. Electric Co., Cincinnati, O. (7th order) 50 H. P. 220v. generator; Conn. River Paper Co., Holyoke, Mass., 700 light dynamo; Grenada Hotel, Chicago, Ill., 450 light dynamo; Leaf Bros., Winchester, Va., 30 light dynamo; Major & Loomis, Hartford, N. C., 25 light dynamo; George W. Furbeck, Chicago, Ill., 250 light dynamo; Badger Lumber Co., Kansas City, Mo., 100 light dynamo; Henry R. Worthington & Co., Brooklyn, N. Y., 600 light dynamo; Diamond Machine Co., Providence, R. I., 250 light dynamo; North Pkg. & Provision Co., Somerville, Mass., (8rd order) 1000 light dynamo; H. S. Sands, Fairmont, West Va., 450 light dynamo; Earl Knitting Mill, Northville, N. Y., 75 light dynamo; Bay State Distillery Co., East Cambridge, Mass., 350 light dynamo; Phelps Publishing Co., Springfield, Mass., 20 H. P. Man. motor; Machinery Supply Co., Los Angeles, Cal., 5 H. P. Man. motor; Connecticut River Paper Co., Holyoke, Mass., 2 15 H. P. Man. motor; Meriden Britannia Co., N. Y. City (2nd order) 8 H. P. Man. motor; Machinery Supply Co., Los Angeles, Cal., 8 H. P. Man. motor; Machinery Supply Co., Los Angeles, Cal., 10 H. P. Man. motor; B. F. Sturtevant & Co., Chicago, Ill., 10 H. P. Man. motor; Electric Construction & Engineering Co., Detroit, Mich., 8 H. P. Man. motor.

STORAGE BATTERY TRACTION IN CLEVELAND.

The following letter, which has recently come into our possession, would go to show that the work of the Ford-Washburn storage battery in Cleveland during the past year, although discontinued from lack of capital on the part of the exploiting company, was not without features of encouragement. The letter is a frank presentation of the case:

Capt. Geo. A. Ford, Cleveland, O.

Dear Sir:—In relation to the storage battery car used upon our Cleveland & Berea line, will say the car came on our road in September, having made a number of trips on the city roads before coming, and started making six trips per day between Cleveland and Berea from Oct. 1st to February, and making a total of about 6,000 miles, and carried about 12,000 passengers. On special occasions, the motor car successfully pulled a trailer, there being upwards of one hundred and fifty passengers on board the train on one trip counted.

Our facilities for charging the batteries were insufficient and of a temporary order. We had no facilities for inspecting the cells, and during the entire time they were used but one set was in service, consequently making it impossible to withdraw one set from the car for charging and inspection while another was in service.

One feature of the service was the placing of the car and its cells entirely in our hands for housing the car, etc., without restriction or rigid continuous inspection of our actions and treatment of the equipment while under our care over night and between trips, by yourself or engineer; in consequence we can unqualifiedly say the equipment of cells in the car when its service was discontinued was the same as when the initial trip was made.

The reason we were obliged to surrender the use of the car and the further entire equipment of our line with your system, was due to the fact that your system in the opinion of bond purchasing investors was not wholly removed from its formative business stages; on account of this condition existing we were deprived of the possibility of placing in service an ideal system for electric suburban traction, and you as well were deprived of the opportunity of showing in long continued use of several equipments the entire practicability of your system.

The cells in the car were sold to Prof. Langley for the use of Case School of

Applied Science and Adelbert College. We learn they have been found, after careful inspection, to be in as good order electrically as when first used, which certainly speaks volumes for the practicability and indestructibility of your cells, since the same cells were subjected to hard usage in service on our road.

The Cleveland and Berea Street Railway Co.

By C. W. D. MILLER, Pr.

SUPPLIES FOR THE WEATHER BUREAU.

The following awards have been made for furnishing the Weather Bureau with telegraph supplies for the fiscal year ending June 30, 1895.

Royce & Marean, Washington, D. C., 80 batteries complete, Leclanche-Gonda prism, small, with sal-ammoniac, 70 cents each; 80 do, large, with sal-ammoniac, 70 cents each; 9,000 pounds blue vitriol, packed in barrels, 3½ cents; 7,000 pounds blue vitriol, packed in 50 pound boxes, \$1.82 per box; 8,000 brackets, insulator, 2 cents each; 150 brushes, battery, bent handle, 25 cents each; 8,000 coppers, gravity battery, 5x7 inch, 4½ cents each; 600 jars, best flint glass, gravity battery, 10 cents each; 50 pliers, Stubs', side cutting, 8-inch, \$1.42 each; 60 do, 5 inch, 63 cents each; 200 porcelain insulators, No. 4, 1 cent each; 20 switches, wooden base, 2 point, 15 cents each; 50 telephone cords, 15 cents each; 4,000 zincs, crowfoot, for gravity battery, 5x7 inch, 11½ cents each; 75 do, for Leclanche-Gonda prism battery, 5 cents each.

The E. S. Greeley & Co., New York, N. Y., 800 connectors, double, 8½ cents each; 2,500 insulators, screw, glass, 2½ cents each; 150 pounds sal-ammoniac, 6¾ cents; 50 syringes, battery, hard rubber, No. 6, \$1.40 each; 10 vises, hand, 5½ inch, with straps, \$1.12½ cents each; 50 pounds each copper wire, office, Phillips' braided water-proof, Nos. 20 and 22, 23 cents.

National Electric Manufacturing Co., Milford, Conn., 150 connectors, single, 5 cents each; 15 keys, telegraph, Bunnell pattern, top connections, 95 cents each; 10 do, bottom connections, 95 cents each; 15 relays, box sounding, with keys, 150 to 200 ohms, \$4.50 each; 20 sounders, telegraph, Giant, \$1.35 each.

W. R. Brixey, New York, N. Y., 12 rolls tape, Kerite, 57 cents; 1,000 feet copper wire, No. 16, B. W. G., 3 conductor cable, 7½ cents; 1,000 feet do, No. 16, B. W. G., 1 conductor cable with braided covering, 2½ cents; 5,000 feet do, insulated, 2 conductor, No. 18, B. W. G., 4½ cents; 500 feet do, Nos. 16 and 18, B. W. G., 9 conductor cable, 18½ cents; 500 feet do, 6 conductor cable, 18 cents.

Bishop Gutta Percha Co., New York, N. Y., 800 feet each, wire, braided, Okonite insulation, Nos. 14, 16, 18, B. W. G., 7-82 insulation, 2¼ cents, 2 cents, 1¾ cents.

LEATHER BELTS.

No one using leather belts can afford to be indifferent to their care. There is a certain amount of elasticity in all good leather belting, but time and continued hard work seem to destroy or at least weaken its power. Then comes the question whether it is better to simply tighten the belt or use some form of dressing. Experience of many very practical observers seems to favor the use of a good dressing, as tightening the belt strains it and calls for more engine power. A dynamo engineer who is transmitting 60-65 H. P. with a 50-foot link belt 8 inches wide, running from a 72-inch pulley on driving shaft to a 13-inch pulley on dynamo, claims that freedom from jumping and flickering of the lights is due entirely to the belt dressing used and that tightening never helped. The superintendent of a large printing establishment has an 18-inch main belt now running its eighth year which has never been taken up, and it would be extremely hard to convince him that the dressing used does not preserve the life of the leather and keep it soft and elastic. Of course one should be careful what sort of dressing is used. Soap, rosin, tar and tallow should not be used at all. Even castor oil is criticised. The dressing used in the two cases cited was Dixon's belt dressing and leather preservative, which was the only article that would start the big driving belt used at the Paris Exposition in 1878, and keep it from slipping. Circulars about the dressing will be sent to any one interested by the Dixon Crucible Co., Jersey City, N. J.

AWARDS FOR THE OERLIKON WORKS.

The Oerlikon Electrical Works, Oerlikon, Switzerland, advise us that at the international exhibitions of Lyons and Antwerp of this year, they have received the highest award, the Grand Prix, for preeminence in the field of electrical industry.

MR. W. R. THOMPSON, for several years in charge of the electrical plant of Jos. Horne & Co. in this city, has recently been appointed to take charge of the electric plant now being erected in the Carnegie Building. This building is fourteen stories high, and is the largest in western Pennsylvania. The electric plant consisting of about 3,000 incandescent lights, is the most important isolated plant in this part of the country. All the apparatus is of the Westinghouse manufacture.

NEW ENGLAND NOTES.

L. A. CHASE & Co., of 161 Fort Hill Square, Boston, are making a specialty of rewinding burned out armatures of any system. They have a well equipped shop, an energetic manager, guarantee satisfaction, and will do repairs as expeditiously and economically as any in the field.

A NEW BRIDGE FOR HARTFORD, CONN.—Besides supplying more than their fair share of the new central stations, factories and other buildings, the Berlin Iron Bridge Co. have a knack of securing a large number of orders for bridges. The latest contract given them is for a new bridge at Hartford over the Connecticut, to cost \$274,000. It will provide for a footway, driveway and trolley car passage, the latter being 12 feet wide. The bridge is to be lighted by electricity. Its entire length is about 1,000 feet.

THE MATHER ELECTRIC COMPANY of Manchester, Conn., have just closed a contract with the Overman Wheel Company for an electric power transmission plant for their works at Chicopee Falls, Mass., consisting of one 100 kw. new-type multipolar generator, two 25, one 20 and one 10 H. P. Manchester motors, with complete switchboard. The Mather Company, who are making a specialty of this class of work, are also installing a similar plant with a 60 kw. generator, in the mill of the Connecticut River Paper Company at Holyoke, Mass. The Mather Company also booked last week the following orders:—One 80 kw. new-type multipolar generator for the Pierpont Mfg. Company, New Bedford (3rd order); 350 light dynamo for the Receivers of the Union Pacific R. R., Pocatello, Idaho; 350 light dynamo for the Rockwell Mfg. Company, Milwaukee, Wis.; 350 light dynamo for the Hub Gore Makers, Brockton, Mass.; 100 kw. railway generator for the Ithaca St. Railway Co., Ithaca, N. Y.; 15 kw. direct connected dynamo, with Ideal engine, for the Wayne Hotel, Detroit, Mich.; 350 light dynamo (ring type) for the Meriden Britannia Co., Meriden, Conn.; 350 light dynamo for the Berlin Iron Bridge Co., East Berlin, Conn.; 150 light dynamo for Curtis & Howard, Minneapolis, Minn.; 250 light dynamo for C. Dorfing, White Mills, Pa.; 150 light dynamo for H. B. Coho & Co., New York City; 15 Manchester motors from 8 to 15 H. P.

THE TAUNTON LOCOMOTIVE MFG. CO., of Taunton, Mass., have for some time been making a specialty of snow ploughs specially designed and adapted for electric railway service, and have this past Fall had a very satisfactory demand for them. This winter they are supplying a plough of entirely new design, protected by patents, the main feature of which is the parallel lifting motion of the nose. Each end of the plough is fitted with one of these noses, the two perfectly counterbalancing one another, so that in operating them, by means of a hand wheel, it is only necessary to overcome the friction of the mechanism. When one nose is down the other is up, and the mechanism for operating is all well forward on the car, so as to clear the axles, and leave plenty of room for any type of electric motor,—one of their most recent sales being fitted with the G. E. 1200 type. Among their most recent sales may be mentioned the following, all for single track roads:—Wakefield & Stoneham Street Railway Co., two; Dartmouth & Westport road, (between New Bedford and Fall River), two; Worcester & Leicester road, two; and one to each of the following roads: Abington & Rockland, Plymouth Street Railway Co., Fitchburg & Leominster, Lewiston & Auburn, and Shamokin & Mount Carmel. Besides these they have also two of last year's pattern to the Bridgeport Traction Co., of Bridgeport, Ct., with double share, for double track work, and have now on hand a plough for the North Hudson County Railway Co., Hoboken, N. J., of this year's pattern, but modified so as to do double track work. In this plough the nose is replaced by a boiler plate share supported by cast iron girders, which is operated by the same lifting mechanism that is used for the single track plough noses.

The Taunton Locomotive Mfg. Co. are peculiarly well equipped for this class of work, having a large, commodious factory, equipped with every kind of machine tool, and plenty of floor space. They have met with so much success in this class of work that next year they will develop still more this department, and have some ploughs to suit every kind of electric railway, single or double track. In the meantime electric railways contemplating the purchase of snow ploughs would do well to get one of their most recent photographs, showing the general appearance of the machine they are now manufacturing.

WESTERN NOTES.

MR. WM. M. DEAN, Electrician of the Bell Telephone Co. of Missouri was a Chicago visitor last week.

THE ELECTRIC APPLIANCE COMPANY are hard at work on an inventory which marks the beginning of their fourth business year. This event will be duly celebrated as soon as possible, by the issue of several sets of advance sheets of the new issue of their general catalogue. The catalogue itself they plan to have ready for distribution early in the spring and promise that it will be a veritable "Chap Book" among catalogues.

MR. J. E. WAY formerly in charge of the western business of the R. Thomas & Sons Co., is now located in New York in general charge of their sales department.

THE R. THOMAS & SONS CO. have moved their western office to 1532 Monadnock Block, Chicago, where the business in the Western States will be handled by the Bryant Electric Company through their western managers, Messrs. Thos. G. and Edward R. Grier.

MR. F. E. DONOHUE, General Western Agent, American Electrical Works, last week succeeded in capturing a nice little order for some \$118,000 worth of trolley, feeder and return wires for the North and West Side electric roads. The order aggregates some 900,000 lbs. of wire and Mr. Donohue feels considerably elated over his success, especially as there was great competition.

MR. S. G. NEILER, late assistant electrical engineer, World's Columbian Exposition, is now permanently associated with Pierce & Richardson, Chicago, who are to be congratulated on securing the services of one whose work during the last few years has proved him to be thoroughly "up to date" in all the details pertaining to the construction of light and power plant.

MR. CHAS. SHARPE, manager of the Southern Electrical Supply Company, St. Louis, was in Chicago on a flying trip last week. Mr. Sharpe reports business good, and says the demand for Okonite products especially is very gratifying. The company, it will be remembered, is the southern branch of the Central Electric Co.

The excessively heavy demand for "O. K." weather-proof wire during the past few months has taxed the ability of the Electric Appliance Company to keep up their stock. As each car-load is received it seems to melt away before it can be placed in position in the stock room. Even with a continuous procession of several car-loads under way it has been impossible to supply the demand. The company now assure their customers, however, that a few weeks will see them in a position to fill any kind of an "O. K." wire order from Chicago stock.

THE MUTUAL ELECTRIC LIGHT & POWER CO., Chicago, which last March secured a franchise for supplying the territory south and west from Thirty-ninth and State streets, within the city limits, with electric light, heat and power, will go into operation within the next two weeks. The site of the new plant is at the northwest corner of Ada and Eighty-ninth streets, 100 by 120 feet, and the cost of construction will be between \$75,000 and \$100,000. It is proposed to operate arc lights first, then incandescent and develop the power and heating features later on. Poles and wires are now being put in through Fernwood, South Englewood, Auburn and Normal Park.

THE OHIO BRASS COMPANY, Mansfield, O., report a large number of initial orders for the reversible and adjustable track brush holders, and steel wire track brooms, which have been followed almost in every case by larger ones. In many instances the entire equipment of motor cars has been provided with these. Among the larger roads using them are the Syracuse St. Ry., Syracuse, N. Y.; the Middletown-Goshen Traction Co., Middletown, N. Y.; the Cumberland Electric Ry., Cumberland, Md.; the Burlington Electric Ry., Burlington, Iowa; the Steinway Ry., Long Island City, N. Y.; the Central Electric Ry., Peoria, Ill. The ease with which these holders can be manipulated, and the saving in consequence in the wear on the track brooms, is a strong recommendation in their favor. Every operator of a street railway company, which requires a device of this sort, should investigate these before placing his order.

SOUTHERN NOTES.

THE WHITTINGHAM ELECTRIC CAR HEATING CO. of Baltimore has been formed by P. B. McLavan, A. Bunn, H. W. Williams, F. Della Torre and C. H. Whittingham, with a capital stock of \$100,000.

NEWARK, DEL.—The new machine shop for the American Hard Fibre Co., at Newark, Del., is now completed. It is designed and built by the Berlin Iron Bridge Co., of East Berlin, Conn., and is 50 ft. wide by 226 ft. long, the roof being made of steel and covered with The Berlin patent anti-condensation corrugated iron roof covering.

RAE ELECTRIC MANUFACTURING CO.

The Rae Electric Mfg. Co. has been formed at Detroit, Mich., with a capital stock of \$2,000 by F. B. Rae, F. H. Date, J. Heffron and B. H. Scranton.

Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.

Vol. XVIII.

DECEMBER 12, 1894.

No. 345.

THE SIGNAL CORPS OF THE U. S. ARMY; INSTRUCTION WORK AT FORT RILEY, KANSAS.

BY

George Heli Guy.



Lieut. Samuel Reber, U. S. A.

THE success of modern military operations depends on the celerity of movement and the concentration of a larger force than the enemy has at any given point. The increased accuracy and range of both artillery and small arms and the use of smokeless powder has rendered imperative rapid and sure means of intercommunication between the various component parts of an army and the prompt transmission of information on

the field of battle and on the march. The present Chinese-Japanese war has taught the armies and navies of the world some most important lessons, of which few are more suggestive in their bearing on modern war methods than the fact that the day following the battle of Ping Yang the Japanese signal and telegraph corps ran into that city a flying telegraph wire extending from Seoul, a distance of 70 miles.

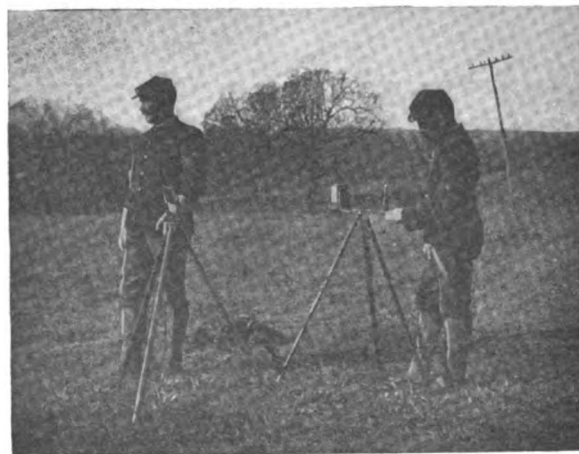
Many of the people of this country imagine that the Signal Corps of the United States Army, is a body of weather observers, and wonder why the weather predictions are made under the direction of the War Department. They forget that a little over two years ago the forecasting of the weather was, by Act of Congress, transferred from the War Department to the Department of Agriculture, and that the Signal Corps is one of the military Staff Corps of the army, whose duty it is to collect and transmit information of all kinds, and to form, in fact, part of the Bureau of Information. The Corps has 10 officers, and 50 sergeants, with Brigadier General A. W. Greeley, of Arctic fame, at its head. This is the peace organization of the Corps. In time of war, the Corps would have to be increased by additional officers and men, sufficient in number to man the various appliances which constitute its equipment. A number of the sergeants are at present employed as operators on military telegraph lines throughout the country, and at the various Department Headquarters, and the rest are at Fort Riley, Kansas, pursuing the course of instruction there.

This course of instruction extends over six months, and consists of both theoretical and practical instruction in electricity, topography, photography, signaling, instruction to

operators, and practice with the field telegraph and captive balloon trains. The practical course of electricity covers the ordinary laboratory measurements of E. M. F., current and resistance, and location of faults in telegraph wires; the construction, use and repair of ordinary telegraph and telephone instruments, and the construction and maintenance of telegraph and telephone lines.

The course in topography and photography includes rapid sketching and reconnaissance work, and the ordinary photographic operations—printing and enlarging; the application of photography to map making is extensively used, and the camera is employed effectively in the captive balloon. The various systems of signaling and cypher are explained, and practice extends over various ranges up to 12 miles, with the flag, heliograph, torch, and flash lantern; and, with the field telegraph kit, using both insulated cable and the bare wire system. The course of instruction to operators consists largely in practice with the Morse system until each of the sergeants can send and receive 35 words a minute, and transcribe 25 words a minute on the typewriter, together with the regulations for transmission of messages and keeping the accounts of the various military lines, on which a considerable amount of commercial work is done.

The means of communication by day used by the Corps are flags, heliograph, and the field telegraph and telephone trains; and by night, the torch, flash-lantern, rockets, bombs and searchlight. The method of visual signaling by flags consists in waving a flag to the right for a dot, to the left for a dash, and to the front for the space in the American Morse code. The heliograph, in brief, consists of a combination of mirrors by which a beam of sunlight is thrown in the required direction, and the dots and dashes of the Morse code are made by the opening and closing of a shutter placed in the track of the beam of sunlight. The heliograph has been used recently by the Corps up to a distance of 182 miles. At night, the Morse code is sent either by the waving of a torch or flashes of light from the flash-lantern, a new type of



THE HELIOGRAPH, U. S. ARMY SIGNAL CORPS.



FIELD TELEGRAPH TRAIN, U. S. ARMY SIGNAL CORPS.

which has been recently designed, of light weight, small size and high penetrating power, the illuminant being coal oil, which is always available. It is the intention of the Chief of the Corps to have a searchlight train—the plans for which have already been prepared—as soon as Congress in its inscrutable wisdom, shall begin to realize the necessity of preparing for war in time of peace.

The outpost cable cart is made of steel, mounted on two wheels, and can be run either by hand or by a horse. It will carry four miles of double cable, each mile being wound on a spool, and paid out in succession. The cart is self winding, and has an ingenious automatic feeding device, so that the wire, as it is reeled in, is wound smoothly. A field kit is attached by a flexible wire to the cart, and communication is always possible, whether the cart is at rest or in motion. The Siemens cable employed is of the ordinary double-conductor type, but strong enough to be crossed by bodies of cavalry and artillery without rupture. The field telephone kit carried by the operator is a leather box $9\frac{1}{2}$ inches long, 8 inches high, and $4\frac{1}{2}$ inches wide. It weighs about 10 lbs., and contains a Morse key on a buzzer circuit, a Berthon-Ader combined transmitter and receiver, and two cells of dry battery. The Morse key is used as a call for the telephone, and—in case the telephone breaks down—to send messages on the buzzer. The receiver and transmitter are in one piece, attached by a flexible cord to the kit, and when the receiver is at the ear, the transmitter is at the mouth, their relative position being adjustable by means of a sliding extension. The box itself is carried slung over the shoulder, and does not in any way impede the progress of the operator. There is, however, an arrangement by which, when the instrument is being used to receive a message, the secondary of the transmitter of the receiving instrument is temporarily short-circuited, thereby cutting out that amount of resistance. It was found in experiments of Capt. Charellois, of the French Army, that the earth itself was sufficient insulation for a telephone line, if not of too great a length, and if the line did not encounter water. This suggested the possibility

of laying a telephone wire on the surface of the ground without insulation, and upon this basis Capt. Charellois evolved his system, in which a hand reel carrying about half a mile of No. 22 hard-drawn copper wire, or wire of bi-metallic type (iron core, copper coated) of the same gauge is employed, in conjunction with the ordinary telephone. Before the Charellois system was adopted in this country by the Signal Corps, experiments were made which proved the expediency of laying the bare copper wire upon the ground. The following are a few of the tests made: Eight miles of this wire was laid on the ground, and conversation was heard very clearly at both ends of the line. On wet ground, however, where there was no standing water, the limit of distinct audibility was 3 miles, and this result was not appreciably changed when the wire was wrapped around a water pipe or gas pipe. A thousand feet of wire was then stretched along the ground, and the line was cut in the centre; this, while not destroying the continuity of the conversation, made it less distinct. The ends of the wire were then pulled 12 feet apart, and speech was heard almost as clearly as before. Each end of the break was then grounded by driving into the earth metal bars, to which the ends of the wire were attached, and in the talk over this seemingly perfect “ground,” the volume of sound was practically undiminished.

The reel first used by the Signal Corps was modeled after that of the French service, which is crude and unsatisfactory; but the appliance has been recently improved by Lieut. Samuel Reber, who is in charge of the School of Instruction of the Signal Corps at Fort Riley. Lieut. Reber is favorably known by his active labors as a member of the Board of Judges in the Department of Electricity at the World's Fair, and as Secretary of Section “B” of the Chicago International Congress of Electricians. He is the electrical expert of the Signal Corps, and has recently rendered valuable service to the Government by his work on the plans for the transmission of the power of the Great Falls of the Potomac to Washington.

The defects of the French model were its weight, slow speed in reeling up, liability of the wire to overrun the reel and jam the axle, and the difficulty of using the brake when the line was ruptured. The practical result of these defects was to render the operation of the reel ineffective and tedious. When the wire overran the reel, it became necessary to take the reel entirely out of the case and sometimes cut out that part of the coil which was around the axle. Another difficulty arose on the relaxation of the tension on the line, either from a break or from a stoppage in the operation of the reel, when the reel would overrun, and the line would coil around the axle. The improved reel obviates these defects, and promises, so far as experiments over short distances have already demonstrated, to be a thoroughly practical and efficient device. These improvements consist in a gearing which enables the operator to reel in the line at a run, and, if mounted, at a trot; a brake, positive in action, which will stop the reel in half a revolution; and a simple device for preventing the wire from ever getting over the reel, and winding around the axle, or enmeshing in the gears. The reel is so



THE OUTPOST CABLE CART AND TELEPHONE KIT.

arranged that it can be attached to the person of the operator, being slung on one side while the field telephone kit is on the other, so that when he starts out, he has a mile of wire on his reel, and a telephone ready to talk to any person whether he be mounted on horse or bicycle or on foot, in motion or at rest. This combination of outpost cable cart and bare wire system gives the Signal Corps a movable and flexible telephone system of the highest adaptability and efficiency.

The field telegraph train, used in the U. S. Army, consists of a battery wagon, and three sections, each of which includes a lance truck, and a wire wagon. The battery wagon is a covered vehicle equipped with partitions for holding "Eagle" blue stone cells, storage space for Morse instruments, and the necessary telegraphic supplies. The wire wagon is covered, and contains a reel for paying out and reeling up No. 14 B. & S. galvanized iron wire, and space for 10 miles of wire. The lance truck is a long open wagon for carrying the lances, or poles. These are of straight ash, 14 feet in length, and capped with either slot or suspension insulators, which can be rapidly attached. The insulators are of gutta percha, and are carried in boxes on the side of the lance truck together with crow bars for digging the holes in which the lances are inserted.

The method of erecting the telegraph line is briefly as follows: At the head of the line the battery wagon is stationed; then a "surveyor" marks the general direction of the line. He is followed by "markers" and "pin men," the markers pacing off the distance of about 55 yards and the pin men placing pins, similar to surveyors "pins," in the ground to mark the location of the poles. These are followed by "crow bar men," who dig holes for the reception of the lances from 18 to 24 inches deep, according to the character of the ground. A lance is delivered from the lance truck, the wire men put the wire which has been laid on the ground from the wire wagon, on the insulators, insert the lances in the holes, haul taut on the line, and tie the wire about every fourth or fifth lance with a tie insulator. When the line reaches the desired point, instruments are joined on, and communication made with the battery wagon, which has an instrument on the line at all times. In favorable country the train should average at least two miles an hour. The balloon train is another factor of the utmost value in modern war tactics.

The ability to discover the movements and position of an enemy is an absolute necessity to a commanding general, and these can be accurately ascertained by an operator in a balloon about 2,500 or 3,000 feet above the surface of the earth, who can scan the country for miles around with a good telescope, and telephone at once whatever he may see to the surface of the earth. The balloon train at Fort Riley consists of three wagons for the carriage of tubes of compressed hydrogen and one wagon for the balloon and appliances for handling it. The tubes are of fluid compressed steel, one cubic foot in capacity, and contain hydrogen at a pressure of 200 atmospheres. These tubes are charged at the compressing plant, which is located at Fort Logan, near Denver, Colorado. The gas is generated

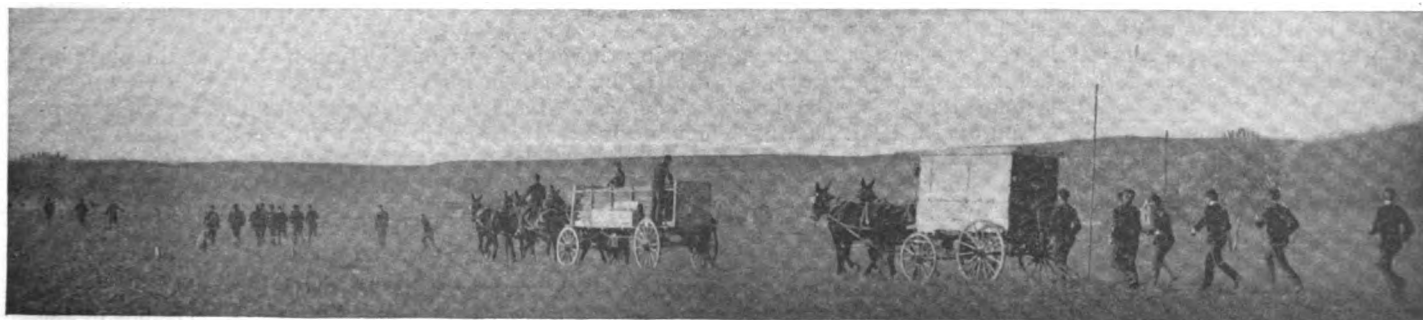
and the tubes filled there and shipped to the point of ascension. The balloon wagon itself has a compartment for storing the balloon, basket and netting, and at the rear has a large drum with gearing and brake. The drum carries 2,500 feet of steel cable, which has in its core two insulated conductors for use on the telephone circuit. The wagon is of such weight as to hold the balloon when inflated by its own weight, and after the balloon has once ascended it may be moved over the ground by simply moving the wagon. The balloon itself is of gold beater's skin, of about 13,000 cubic feet capacity and, when distended, is of spherical shape with



THE SIGNAL BALLOON, U. S. ARMY SIGNAL CORPS.

a slight elongation at the neck. The netting is constructed of cotton twine and covers two-thirds of the balloon, beginning with 100 3-inch meshes at the top and gradually increasing in size of mesh to the centre. Thence downwards the meshes are uniform, their number diminishing to conform to the decreasing size of the balloon. The balloon envelope and netting are attached to the ring of the valve; the bottom of the netting is concentrated and attached to the trapeze from which the basket is suspended, connection being made by means of loops and toggles. The car or basket is of willow wicker work, light but strong, and sufficiently large to carry two observers, with the necessary amount of ballast and equipment.

The balloon is filled by attaching a linen hose to its neck, inserting the tops of the gas cylinders in the hose, and opening the valves of the cylinders. It takes about



ERECTING A FIELD TELEGRAPH LINE, SIGNAL CORPS, U. S. ARMY.

108 cylinders at 120 atmospheres pressure to fill the balloon, and after its inflation the gas is retained for a long period. If there should be an escape of gas over night, the deficiency is made up from one of the tubes. When the balloon is inflated the maneuvering bar is attached to the end of the cable on the drum of the balloon wagon, and the necessary amount of cable is paid out. The height of the balloon above the ground is, of course, regulated by the length of cable paid out, and the observer in the car, having a field kit telephone, can direct the manipulation of the balloon itself as occasion may require.

The equipment of the car consists of an aneroid barometer, prismatic compass, telescope, field glasses, note book



BALLOON WAGON, SIGNAL CORPS, U. S. ARMY

and pencil, telephone, maps of the country and a camera. The operator is thus fully prepared for photographic work, and observation. It may be thought that a balloon would present a good target to the enemy; but the experiments at Shoeburyness with an old captive balloon, showed that it is almost impossible to hit such an object with long range musketry fire, or by artillery fire, especially if it be kept moving, which it always would be. It was also shown by these experiments that the balloon, when filled full of holes by a shrapnel, settled gradually and gently to the earth. When struck it was about 2000 feet high, and it took 27 minutes to descend to the ground. The advantage that a force possessing a balloon train has over a less favored enemy is manifest, and the moral effect of seeing your opponent spying out from the sky your own dispositions and carefully planned and concealed manoeuvres is appalling. All the great nations have equipped their armies with captive balloon trains, and the individual processes of manipulation are regarded as military secrets and are jealously guarded. The French claim to possess a dirigible balloon, and if its practicability be established, the machine should prove a most destructive and powerful engine of war.

The latest developments in these and other departments of war practice are promptly investigated at Fort Riley, and, where necessary, incorporated in the course of instruction in the Signal School. This course has for the last four years been under the direction of Lieut. J. E. Maxfield, Signal Corps, U. S. Army, who deserves great credit for the results he has achieved. His tour of duty having terminated, he was recently relieved by Lieut. Reber, who will complete the instruction of the detachment now stationed at the post.

Extended notice of the social and topographical features of Fort Riley is somewhat beyond the scope of the present writing, but I may mention, as an interesting fact, that this ideal spot for the training of soldiers, situated in the

heart of Kansas, stands on the geographical centre of the United States. The garrison numbers nearly one thousand, and the reservation covers about 40 square miles. It would be difficult to imagine a community in which a visitor could meet with a warmer welcome, and I cannot close this article without an acknowledgment of the extreme courtesy and kindness I received at the hands of every one, and especially the officers of the 7th Cavalry, during my stay at the post.

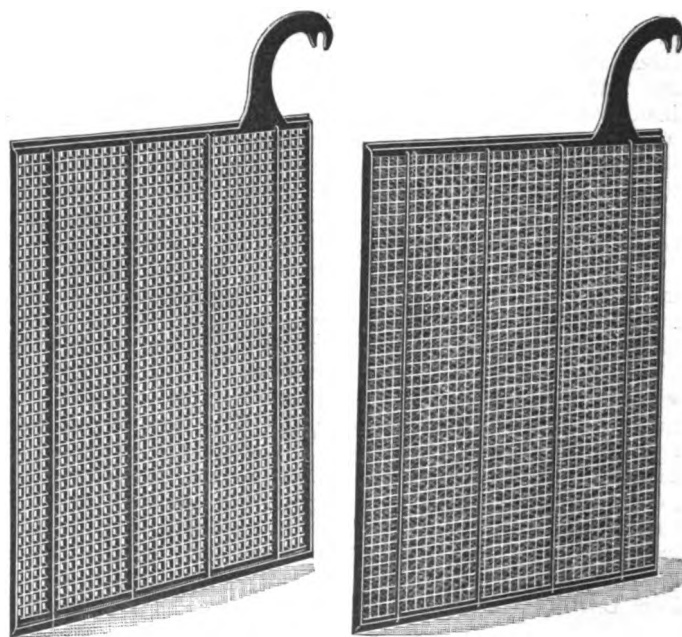
FORT RILEY, KANSAS.

THE HESS STORAGE BATTERY.

NOTWITHSTANDING the many forms and modifications which the storage battery has undergone, both to improve its efficiency and to avoid clashing with the claims of existing patents, there are still others brought out from time to time and the latest to claim attention is the battery devised by Mr. H. K. Hess, of the Hess Storage Battery Co., of Philadelphia.

The distinguishing features of this cell are that no portion of the metallic part of the plate is exposed to the direct action of the electrolyte and that the active material is applied to the plates after the latter are immersed in the electrolyte.

To carry out these provisions use is made of a double-electrode. Instead of pasting the active material upon a single lead plate, exposed directly to the action of the electrolyte, in the Hess battery the plates, composed of lead, are in pairs, forming a double electrode for the active material, which is interposed between the two plates. These plates are perforated, as shown in Fig. 1, and are entirely covered with an insulating material ex-



FIGS. 1 AND 2.—HESS STORAGE BATTERY PLATE.

cepting those portions of the inner faces of the plate indicated by the light lines in Fig. 2.

The perforations of the plates are filled with a non-conducting material of great porosity, composed of quartz sand, the particles of which are held together by asphalt. Two of these plates are put together with the exposed lead surfaces facing each other and about $\frac{1}{4}$ inch apart, and are so arranged that the exposed lines, both vertical and horizontal, of one plate are not directly opposite the corresponding lines on the other plate, but half a space removed, thus reducing the dimensions of the squares formed by the exposed lines one-half, and doubling the amount of conducting surface. By this arrangement

no more metal is required for a double electrode than is customarily used in the ordinary type of pasted grid.

These electrodes are assembled in the usual manner—positive and negative—the double electrode with its two

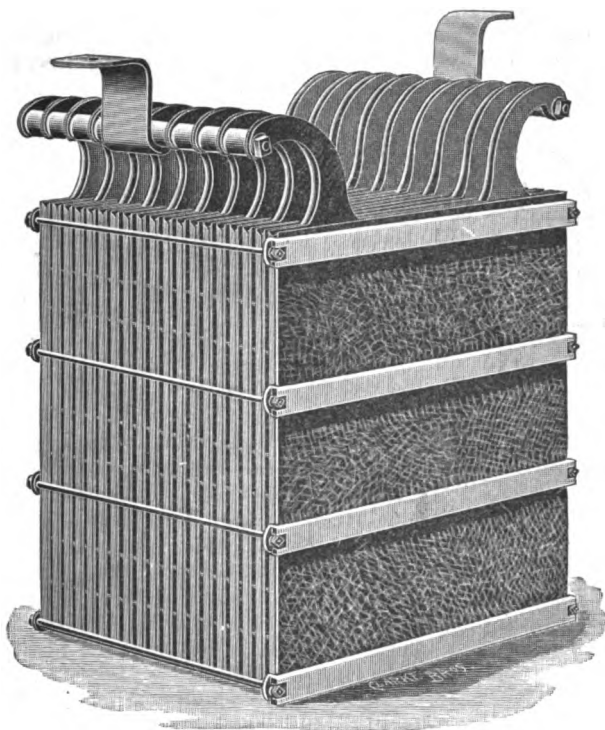


FIG. 3.—HESS STORAGE BATTERY,—PLATES ASSEMBLED.

plates representing but one element. The insulators or separators between the adjacent double electrodes are hard rubber strips, with buttons at intervals of two inches. The object of using separators of this particular construction is to allow a free circulation of the electrolyte from all parts of the cell between the plates. The electrodes are held

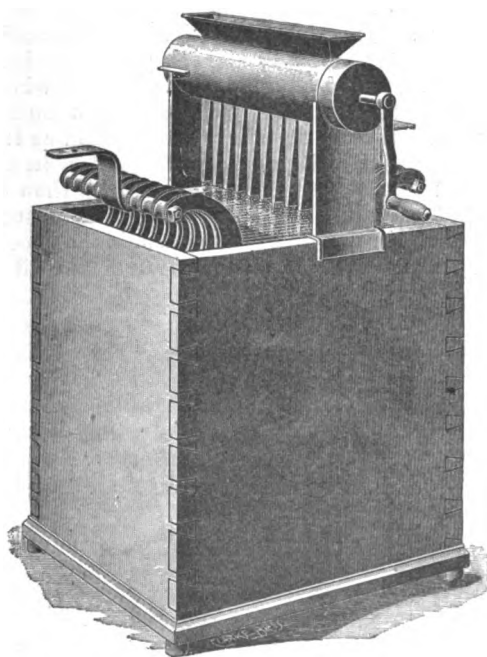


FIG. 4.—HESS STORAGE BATTERY WITH CONVEYER.

together as indicated in Fig. 3, soft rubber washers being used to allow for expansion.

After the assembling of the electrodes they are placed in the cell, which is constructed of wood, and lined with

thin sheet lead. The electrolyte is then introduced, completely immersing the electrodes, and the cell is then ready for receiving the active material.

In the application of the active material a conveyor is used, as shown in Fig. 4. The illustration shows the conveyor applied to a single cell, but in setting up a battery installation the material is applied to the entire set of cells by the operation of a continuous conveyor. This conveyor forces the active material into tubes or chutes, which register with the spaces between the two plates of each electrode; from these conductors the active material falls between the plates, until the space is filled, thus being brought into contact with the exposed conducting surfaces of the plates shown by the lines in Fig. 2, and the cell is then ready for the charging current.

Fig. 4 shows a completed cell whose dimensions are 19x21x24 inches, composed of nineteen electrodes 18x20 inches, with conveyor for the introduction of the active material.

The construction above described has also been adopted in what is perhaps the largest storage cell ever constructed. It is composed of thirty-one electrodes 29x31 inches, and measures 32x33x36 inches. It is intended for central station work where accumulators of large storage capacity are required.

The Hess cell has a capacity of 5 ampere-hours per pound of positive plate, and a 100 lb. battery has a capacity of 250 ampere-hours.

ELECTRICAL MACHINIST PRACTICE.—XIII.

BY

James F. Hobart,

When long "solid" boxes have to be finished up, it is customary to bore them to the required size, ream if necessary, then force them upon an arbor and face up the ends, or the angle piece by which the box is to be bolted to the dynamo or other machine. In work more than four or five inches in diameter, which was cored out when cast, it is frequently quite a problem to get the ends faced up true with the bore. In boring, the casting must first be bolted to the face plate, and trued up as near as possible by the bore; one end can then be faced, and the casting must then be turned end for end, again bolted, and the other end faced up. Sometimes this is varied by bolting a slide rest to the face plate, mounting the work on the carriage, and facing up in that manner.

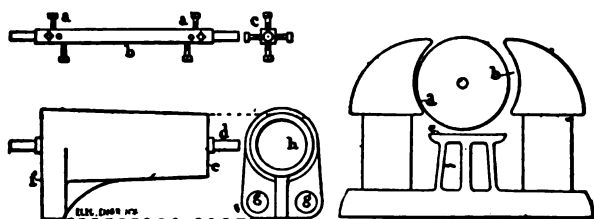
A very handy tool for this class of work is shown in Fig. 59. The square bar *b*, is turned up at each end as shown, and drilled and tapped for the bolts *a a*, four in each end, as shown at *c*. To use this tool, it is put into the casting as shown in Fig. 60 at *d*. An end view of this casting without the "facing-up bar" is shown at *h*. The bar is centered by adjusting the screws, which are finally tightened enough to hold the casting in place, without a slip, against the thrust of the facing tool. After the ends *e*, and *f*, have been finished, it is certain that the two faces are absolutely in line with each other; the facing-up bar can then be removed, and the casting fastened to the face plate by bolts through the holes *g, g*. The boring may now be done with the certainty that it will be true with the ends already faced up.

Speaking of boring, brings to mind the practice, now almost universal, of planing the pedestals, *a*, Fig. 61, upon which the armature bearings are bolted. To ensure good work, the surfaces between pedestal and box should be broken up into different planes so the box can have end motion, but no side motion. This, however, is expensive, and makes the subsequent fitting of the box also more costly, so it is frequently

omitted altogether and the box held in place by the bolts and a pair of dowel pins. But the pins are also omitted frequently, or get taken out and left out in some overhauling after the dynamo is in use, and the box left with nothing but the bolts to hold it in place. And then trouble begins. As soon as nothing but bolts are to be depended upon to hold the box, the bolts get loose and allow the box to move sidewise, urged on by the pull of the belt, and perhaps by magnetic conditions. The result of continuous "loose running" is shown at *a* and *b*, the armature having got out of line and into danger of contact with one of the pole pieces, which would cause no end of trouble immediately. Even if the pins, grooves and bolts hold fast, it is not surprising that one of the boxes may have been placed wrong when the machine was built.

There is a way of avoiding all this trouble, both the real and the possible, shown in Fig. 62. Instead of planing off the top of each pedestal, it is bored off at the same time that the fields are bored out. By this method, the pedestals and fields *must* come true and in line, however roughly they may have been bored. If a box is bolted to *a b* it must stay in line as long as there are bolts enough in it to keep it on the pedestal. Fig. 63 shows how the bearing may be adjusted, or how it adjusts itself, for the box *a* may be placed upon the pedestal *b* in almost any way and not be out of line. In fact, the box is perfectly self adjusting, and remains central, in the axis of the fields whether moved out to *a*, or thrown in the other direction to *d*.

The labor saved in fitting a dynamo for its journal



FIGS. 59, 60 AND 61.

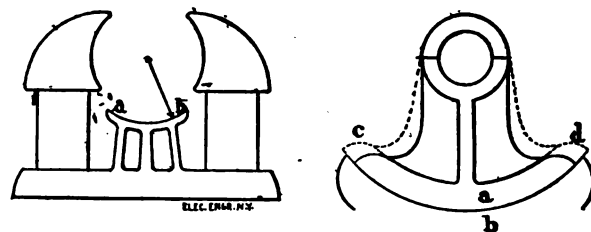
bearings in this manner is a considerable item of the whole machine shop bill. The method has long been adopted by the builders of some high grade engines and is equally applicable to dynamo and motor construction. In fact some motor builders have adopted this method of fitting and find that it gives excellent results. The boxes may be as easily fitted as are the pedestals. It is only necessary to fit up the box and cap with brasses or babbitt, then clamp them upon an arbor and turn off to a certain diameter, and the work is finished.

Once the boxes are firmly fixed to the pedestal castings of the bed plate, there are two other very essential points to be considered in regard to dynamo or motor bearings. These are: adjustment, in shop and station, and facility of oil distribution. Effective oil distribution must be secured, and a continuous supply maintained. Without both of these, no electric machine will give satisfaction. Oil cups and grooves cut in the boxes as described in a previous paper, secure a fair distribution, but for continuous hard service, and the least possible care, I prefer the reservoir oil box fitted with two or more oil rings.

The proper adjustment of armature bearings should be made in the shop, and in a solid anti-friction-metal box. The solid box cannot be adjusted to take up wear, neither can it be tampered with by the would-be mechanic who runs amuck with a monkey wrench. A steel bearing, well fitted to a composition "brass" and well lubricated, will run for many months, under ordinary conditions, without showing enough wear to make "taking-up" a necessity. When lost motion must be taken up, remove the old solid brasses, and put in new ones. These remarks apply more to motors that are running elevators, pumps, and other

machinery in out-of-the-way isolated locations, than they do to station dynamos, but the principle is the same in both cases and needs only to be modified by existing conditions.

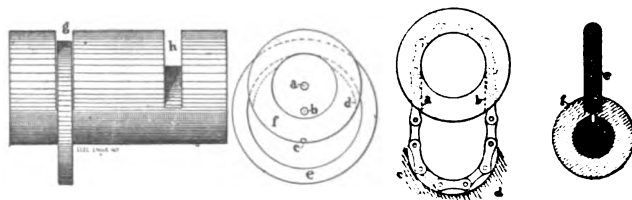
The journal brasses of all motors up to 15 or 20 horse power may well be made solid. The pattern shown in Fig. 64, will give good results. This bearing is a brass or bronze casting, cored out and reamed to the required size. The ring channels *g* and *h* may be cast in, but enough



FIGS. 62 AND 63.

metal must be left to finish upon. In machining this brass, the body is turned up on the centre *a*, and then the box is put into a jig with centres at *b*. From this centre the ring channels are turned up. The depth of the channel is indicated by the dotted line *d*. It is evidently deep enough as soon as the tool gets into the shaft space in the brass. The inner diameter of the ring is fixed by the external diameter of the brass *f*. The ring must be large enough to go over the bearing; that is the only requirement, or limitation, as to size. To keep the brass from revolving, a small feather let in at *c*, on a set-screw or pin will answer. This feather, screw or pin must also be made to fit the jig upon which the brass is put when the ring channels are being turned. The jig need only be a simple shell of brass or iron. It must, however, be so made that a crescent shaped cross section, like that between *e* and *c*, will give strength enough to stand the strain of turning, and the thrust of the lathe centres.

A chain, instead of a ring, is preferred by some manufacturers, but if a chain is to be used, the channel must be made somewhat differently from that used when a ring is to be employed. An "oil chain," instead of an oil ring is shown in Fig. 65. This device is used principally for small bearings, and can be applied in positions where there is not room for the oil ring. The box must be cut away much more for the chain, than for the ring, as the chain must hang in a vertical position at *a* and *b*, in order to work well. This gives the chain more drop than the ring can have, and therefore it can reach to the bottom of an oil reservoir, *c, d*, much deeper than would be necessary in the case of the oil ring. A modification of the oil chain is



FIGS. 64, 65 AND 66.

often useful in cooling a heated bearing. A felt, or other textile band can be rigged on the shaft close to the hot bearing. If the band is allowed to dip into a pail of water, it will carry off a good deal of heat, provided the water is cool, and kept cool.

A self acting oiling device for fan, and other very small motors, is shown in Fig. 66. It consists of a simple closed tube *e*, made preferably of copper, on account of its heat conducting quality, and plated on the outside to match its

surroundings; the tube is filled with Albany grease and inserted in a hole in the box *f*. A small hole communicates with the bearing, and any heating of the latter melts a little grease sufficiently to cool it off again.

The device for facing off the ends of castings, is particularly applicable to the worm box, or casing, used with electrically driven elevators. Such a casing has a good deal of facing and boring about it, and all surfaces must be true with each other. The only way in which such exactness can be secured is by finishing up the entire casting at a single setting in the lathe, or on the vertical radial drill. Facing can be done to advantage on one of these tools, under certain conditions at least, by using end mills with a central projection to fit the drilled or bored hole which must be finished first. When the surface to be faced off is comparatively narrow, a tool may be used in the vertical drill, resembling somewhat a boring bar, made to fit the finished hole. The facing is done by a tool something like a lathe side tool which is put into a mortise in the bar, and held there by a set screw. This tool is handier than the end mill, as it can be set and adjusted to many kinds of different work.

In connecting electric motors to drum elevators, it is very necessary that there be some kind of flexible joint or coupling between the worm and motor shaft. No matter how well or exact the fitting of both machines may have been done, there is a strong possibility that the two will not be in exact alignment when both are bolted to the base casting. Even if absolutely exact when sent from the shop, the shafts would not stay in line, but would commence to get out as soon as the machines were started, and the errors would steadily increase as wear of the parts progressed, until serious trouble was caused by the binding of the parts. Bending or breaking of the motor shaft is one of the possibilities.

To provide such a flexible coupling is a problem which confronts all electric elevator builders, and also workers in many other fields. A very good connection is to put a flange, or face plate on the opposing ends of either shaft, then mortise into each plate (which is much like an ordinary flange coupling) a flat piece of steel having a width and length equal to $2\frac{1}{2}$ or 3 diameters of the shafts to be connected. The thickness of the steel connection should be about two-thirds the diameter of the shafts. This connecting bar may be fixed tightly into one of the flanges, or it may be given a working fit in both, with the flange grooves slightly dovetailed so as to admit of a little movement of the connecting bar. A small amount of movement edgewise is also provided. The flanges are thus connected up like a number of rolling mill trains, that is, they can be somewhat out of line, but they must *go* until something *breaks*.

LUMINESCENCE OF GLASS DUE TO CATHODE RAYS.

At the last meeting of the London Physical Society Mr. Burke communicated a paper "On a Suggestion of Prof. J. J. Thomson in Connection with the Luminescence of Glass due to Cathode Rays."

More than a hundred years ago Beccaria observed that when vacuum-bulbs were broken in the dark, a light consisting of a faint glow was produced in the place where the bulb lay. Beccaria was led by his experiments to attribute this effect to the rushing of air against the glass walls of the exhausted vessel; and in his "Recent Researches in Electricity and Magnetism, Prof. J. J. Thomson indicates its possible close relationship to Mr. Crookes's theory of the luminescence of the glass in Geissler's tubes. The author, however, has made numerous experiments on the breaking of glow lamps, and on the admission of air to an exhausted chamber by the breaking of a thin plate of glass or of a piece of bladder closing an aperture in the walls. In these cases, and in other cases where it was possible for fragments of solid to be projected against the walls of the vessel, a luminous appearance was obtained; while in other cases, where such solid fragments would be absent, no luminosity was observed. The author concludes that Beccaria's phenomenon was due to the impact of glass against glass, and not to the rush of air against the walls of the broken vessel.

SOME ASPECTS OF ELECTRICAL EDUCATION.

(Concluded.)

BY

H. M. Stuy

II. The Education of the Electrician.

By the laws of common usage the term Electrician has come to be indiscriminately applied to all who are in any way busied with either theoretical or practical electrics. It is in a manner a broad class term applicable to the humblest dynamo tender, as well as to the most renowned investigator. The word is here applied in much the same sense as "mechanic" is used in contradistinction to that of "mechanical engineer." The electrician proper is one who is concerned mainly with the construction and maintenance of applied electrics. But the two classes, the electrical engineer and the electrician, cannot in all cases be sharply distinguished, owing to the unsettled conditions which have resulted from the newness of these classes of occupation.

Reference has already been made to a more recent phase of electrical education as the one most difficult of solution. If it were transient, it might be left to its own solution, but since it affects an increasing number of men it deserves the most careful discussion.

No casual review, even, of the electrical situation can be complete which does not recognize the marvelous results accomplished by electricity. But it is apparent to the thoughtful worker that the great majority of those engaged in electrical applications are greatly deficient in the training their occupation demands. The present financial crisis has affected the electrical interests more severely probably than anything else. The pressing demand for workmen and the large returns on invested capital have attracted thousands to engage in electrical occupations who were in no respect competent. Men who could not distinguish between a volt and an incandescent filament rushed into the supply business or into the manufacturing of some specialty. But the design and construction of dynamo and motor and even measuring apparatus, has not been free from this presumption. This was all to be expected from the feverish condition of the industry; and that electricity has been able to accomplish such marvelous results on such meagre knowledge only proves its inherent power. All this would seem to indicate that the cause of electrical education would be immensely benefitted by such a condition of affairs. This has not been the case. It is a common saying that it requires a certain degree of knowledge to become aware of one's ignorance. A great many never acquired this, and their apparent success created a spirit of bigotry.

Before the advent of the bell-hanger electrician, probably no one class of men were more bigoted than the ordinary, but skillful machinists. In the eyes of this class practice is sublimely superior to the knowledge of the deeper relations which have made their work possible. Equally reprehensible was the attitude of the purely theoretical class. Caste with them obscured common sense, and some even went so far as to hurl innuendoes at the man who could be so presumptuous as to apply his knowledge to serve practical ends and seek a patent for it. Happily this latter condition has almost passed away, but the former still remains. It is evident that both the theoretical and the practical classes must give each other due recognition and drop pedantry on the one hand and presumption on the other.

Probably few outside the class actively engaged in electrical education appreciate the very prevalent and urgent desire on the part of many for at least a sufficient knowledge of electrics to enable them to succeed in the line of work they have adopted. The appeals are at times so urgent that they have almost a vein of sadness in them. The man who through long years of hard work has become a skillful steam engineer, realizes that he can no longer hold his own unless he becomes familiar not only with the care of, but to some extent with the principles underlying, the dynamo. The electric railway, the telephone, the battery, the problem of wiring and general installation, all demand from most of the men engaged upon them more knowledge than they possess. Many young men from mere boyish love of machinery have hung around electrical installations until they have picked up sufficient to obtain a situation and with true American pluck desire to rise in their chosen field of work. The numerous electrical factories have created a class of men who realize that their best interests demand a wider knowledge of their daily duties.

And, in passing, still another class may be noted,—the young men whose relatives are anxious that they enter upon a line of work of such promise, but who, having been unable to properly educate them, want in some measure to make amends for this with economy of time. These all desire a certain extent of training, but almost universally want to obtain it on the "business college" plan. This may be regarded as a comprehensive statement of the problem and the details of its solution may now be considered.

An electrical occupation cannot be regarded wholly as a trade. There is a large element of manual facility in a great number of cases, but this necessitates to a great extent the exercise of judgment and knowledge not demanded from the ordinary artisan. It is not sufficient that a wireman should be able to make a neat joint and place his wires symmetrically, but should understand a great deal concerning insulation, the heating and electromagnetic effects of currents, as well as understand something of the character and extent of the electrical pressure to be passed along the wires he is stringing.

Those desirous of commencing a course of electrical study almost invariably state that they have only time or inclination to study electricity and wish to consider nothing else, and wish to begin this study without further preparation. Many writers of electrical books and articles are to blame for this. In their attempts to popularize their subject, they have dogmatized when their own knowledge was deficient and sought to eradicate from their writings all mathematics and the fundamental sciences upon which electricity is based. They have offered to the public explanations and rules which are professed to be complete and exhaustive, when in reality they have been faulty or meaningless. Books of less than one hundred pages have boastfully claimed to contain all about some of the most difficult matters which the true electricians consider, and which they, with a full library at hand, modestly feel they have by no means exhausted. Others again in the introductory chapters have sneered at the mathematical and scientific writers and have sought to convince their readers that about all of the principles of the dynamo and electrical transmission with their accompanying measuring instruments have originated in the engine room.

On the other hand many books written by able men have been largely taken up with descriptions of types having only historical interest, and others whose existence was merely ephemeral, and the reader has searched in vain for an explanation of those forms with which he comes in daily contact. Others which were professed to be practical treatises have been filled with rambling discussions of laboratory methods which have but little real connection with the needs of the actual electrician. It is in the natural order of things that a prejudice should thus have originated against the fundamental knowledge of certain sciences and mathematics and the belief become general that electricity may be studied by itself and may be begun at once, irrespective of preparation.

The class of students we are now considering have very little conception of what electrical facts or theories they wish to study; hence it may not be amiss to define somewhat a course of study with reference to subject matter, rather than the particular order in which it should be taken up. The greatest importance would attach to the study of the system of units, fundamental, mechanical, magnetic, and electro-magnetic. While it might not be judicious to attempt to comprehend all the units which electricians have seen fit to adopt nor to carry any of them out to their absolute bearings, yet the majority have practical values whose relations to one another may be mastered without special difficulty. This is certainly as true of the watt, weber, and farad, as of the horsepower and foot-pound. What is here insisted upon is not the mere verbal acquaintance with these units, and the ability to instantly state their numerical value, but rather that a true physical conception or picture be formed of what is generally accepted as the relations or conditions involved, and of which the unit is but a particular part agreed upon to measure the extent of similar conditions in general. If in this connection an elementary treatment of potential is properly presented it can be grasped and at once enables the student to obtain a very satisfactory conception of the different conditions to which these units apply.

Static electricity should receive sufficient attention to become familiar with the mutual actions of static charges. The salient facts of magnetism and the electromagnetic effects of a current must of course furnish the immediate basis for the study of all ordinary forms of electrical devices. The action of the battery cell in setting up and maintaining a difference of potential with accompanying problems; electrolysis in general and electroplating in particular may all be studied to a greater or less extent. The principles of the dynamo, motor, and leading associated devices will be the leading topic of study, but it no longer suffices to understand the comparatively simple forms designed for continuous currents, but the student must needs attempt to master the rudiments of the complexities of the alternate current, and the apparatus generating and used in connection with this. These various lines of study cannot be followed except through appropriate practical and scientific apparatus, and the work should be accompanied by frequent practice in the measurement of as many of the conditions considered as possible.

Wires and wiring calculations involve a study of the heating effects of current, the effect of change of temperature on the resistance of substances, relative conductivity, insulation and other associated details. But it is not the desire of the writer to attempt an exhaustive outline of study, but merely to make the outline suggestive, and to state what the electrician should aim to know to become competent to master his work.

The inquiry naturally arises, what preparation, if any, is

needed for such a course. Let a specific case be considered. The student desires to know something concerning the construction and action of certain primary batteries. The knowledge to be of real benefit must include the chemical changes in these batteries. Before the battery can be properly studied, one must become familiar with the most elementary conceptions of chemistry. The student will then know but little definitely concerning the action of the batteries unless he can both read and plot their curves of polarization and recovery. To understand a curve properly a knowledge of geometry is requisite, otherwise curve plotting is purely mechanical and the real relations sought to be expressed through this method of recording will not be apparent.

The sophistries of the writers of non-mathematical books and articles must soon become apparent to the common-sense student. He will perceive that he is unable to grasp the conceptions of these writers, and that they, in their attempts to express certain ideas without resort to direct mathematical expressions, do so only in consequence of previous mathematical thought and study. Scarcely any electrical subjects can be rationally discussed without a direct or an indirect appeal to mathematical methods. A writer in consequence of previous mathematical training may succeed from the merely descriptive standpoint in explaining most electrical phenomena and apparatus, but this will not be common ground for his unmathematical readers, who are not able to reach up to his conceptions. The least requisite mathematical training for satisfactory electrical study would then seem to include a reasonable comprehension of the elements of algebra and geometry with a knowledge of the elementary functions of angles as obtained from a study of the barest elements of trigonometry. Lastly, but by no means the least important, is the study of the elements of the principles of physics. This would especially include the study of the properties of matter, force, and energy relations with their applications in the subdivisions of light, heat, and sound.

This may be objected to as excessive, and beyond the reach of all except the favored few who can avail themselves of the advantages of the schools. But this objection is irrelevant to the subject which considers the needful preparation for profitable electrical study. Because the preparation is beyond the reach of certain persons can only mean they must forego electrical study. How, for example, can even an elementary and simple treatment of the principles and complexities of the alternate current in its circuit and generation, be understood without the requisite training, though it be presented in such an admirable and concise manner as has been done in one or two instances.¹

So far the problem and its solution seems clear and reasonable. The complexities which it assumes only become apparent when the question of ways and means is raised. It is this aspect of the case which has called forth the present article. These difficulties can be again best dealt with after considering an actual case selected from hundreds to which the attention of the writer has been called. The subject resides in a section of our country where educational facilities are scant. He is a young man, twenty-one years of age, who has been employed in the powerhouse of an electric light and street railway company for about four years, and before that time he was working in a machine shop. His present employers have great confidence in his skill and ability and trust him in cases of responsibility. He has saved some money and desires to attend lectures on the subject of electricity and to study all about the late improvements in electrical machinery, besides the construction of electrical apparatus. His early education has been somewhat neglected so that it would be very difficult for him to take up the studies laid down by the schools. He has no desire to enter a school for a degree or diploma, merely wishing to enter as a special student. He is able to pay his way for about two years.

To the thoughtful person, versed in such matters, this is a case for the gravest consideration. Here is a young man, who, after four years of practical experience under good conditions, realizes that, however important mere practical experience and ability may be, in order to properly succeed, he must supplement this with as much knowledge of his subject as he can obtain. So clearly is this appreciated that he has saved from his earnings to accomplish this end. His attitude shows the true American spirit of progress, which lies at the bottom of the rapid strides our country is making, and argues that, can he be given a chance, his career will be an assured success.

There seems to be but one solution to the problem he suggests. A school or tutor should be selected which will give him the proper preparatory training with economy of time. If his means will permit of nothing further the preparatory training should be thoroughly gone through with. Then, if impossible to remain longer at school, he will have the requisite foundation for electrical study. This he can pursue with advantage for himself, making use of every opportunity offered to study the practical demonstration and applications of electrical theories.

On the other hand, should he become discouraged at acquiring the necessary preparation because he cannot complete his studies, and continue on content with what he has learned from practice, failure in his line of work undoubtedly awaits him. Unless he be

1. "Alternate Current Wiring and Distribution," by W. LeR. Emmett.

especially gifted he will soon reach the heights to which he may attain, and then will experience the mortification of seeing others constantly promoted past him because they knew more than himself. We feel convinced that this is the true aspect of the case, and that exceptions are as a rule due to favoritism and commercial trickery.

Another conclusion to be drawn from somewhat similar cases is their hopelessness. Young men whose early education has been neglected, often insist that they only want to study purely electrical matters, and can only devote a year or so to these matters. Their expressed ambition is to rise above their position as electrical artisans to that of the electrical engineer. Their best interests demand that the impossibility of this procedure be plainly pointed out to them. They cannot hope to cope with men who have had all the advantages of a thorough preliminary training and have supplemented this with years of purely technical study and experience. This seems to be the only road to the coveted position of the successful electrical engineer, and those who are debarred from travelling it must be content to be shut out from the goal. The example of a few leading electricians of the past, as well as some of the living, may be cited to the contrary. But these men have in all cases been favored with the proper preparatory foundation and been so situated that they have had access to extensive libraries and apparatus equipments, when by dissecting, comparing and studying they have been able to master the science in whole or in part. There are a few others who seem to have achieved success independent even of any education, but this success may be more apparent than real. But such men are true geniuses and cannot be taken as the gauge for men in general.

Such thoughtless demands for quick electrical education are in keeping with the business college idea. One is led to imagine many people look upon schools as a class of educational factories, busied with the manufacture of such specialties as will catch the popular demand, and where the process may be hurried up by working over time to keep up with pressing orders.

The preparation and electrical course of training for the electrician having been defined the means for obtaining these must be discussed. We may be pardoned for omitting further discussion and confine our attention wholly to the organized means for education,—the schools in their various forms.

Schools for imparting specialized instruction may be divided into three classes,—the purely technical school, fitting men for the engineering profession; the training school for the education of the electrician; the trade's school, preparing men to become thorough electrical artisans. There exist many efficient schools covering the first and third classes, but the second as yet does not. Judging from the demand and the importance of the work to be done, the purely electrical training school has before it the broadest field of usefulness in the world of technical education. The organization of such a school would be solely for the purpose of teaching the ordinary applications of electricity and the elementary principles underlying them. Mathematics would be simply and thoroughly taught and only to the extent demanded by this class of work. The same considerations would govern the instruction in chemistry, physics, and mechanics. Steam engineering should be here taught more by practice work than by the theory of the class room. The entire work of the institution should be thoroughly coordinated to the end that its students should be as thoroughly prepared as possible to become intelligent electricians, rather than designers and scientific investigators. Invention might be encouraged only so far as it involved the mere elementary principles of the science; and in case students should show marked ability for higher scientific work they should be encouraged to attend a technical school proper. This meagre outline is certainly suggestive of great possibilities for usefulness.

There is one class of trade schools which has appealed strongly to the public mind,—the factory courses offered by a number of leading electrical concerns. Much can be said in praise of these, but their limitations need to be pointed out. To young men of thorough mathematical and scientific training they offer admirable opportunities for practice and further study. In the nature of the case they can offer but little more than practical training, and this of the narrowest and most individual character. They exist solely for the commercial purpose of training men to properly operate their own make of apparatus, and all that a student acquires beyond this is due more to his own shrewdness than their intentions. In short they serve as admirable supplements to an electrical education, but should not be relied upon to impart the education itself.

Further, the Chautauqua idea, more or less modified, has recently assumed considerable importance in the electrical educational work. The leaflets, for example, issued by THE ELECTRICAL ENGINEER, and compiled by both competent and able men, are deserving of the highest commendation. When the preliminary education is sufficient, they are among the best means for obtaining self-education in electrical matters. They are of the greatest assistance to both the practicing engineer and the student in that they define the electrical terms and units accurately and serve to coordinate general knowledge and reading by presenting principles in their proper

order and relations. This is also true of some of the lessons sent out by one or two correspondence schools. It must be recognized, however, that electrical instruction needs to be very largely supplemented by demonstration and laboratory practice. For obvious financial reasons, leaflets or lessons cannot be accompanied with the requisite apparatus which they demand for their full comprehension. It needs a greater equipment of apparatus than a combined dynamo and motor, a primitive galvanometer which may be universally employed as both ammeter and voltmeter to illustrate archaic and abandoned methods of construction, joined with a battery and a few wires and bits of glass, to attempt to impart even an elementary education. These methods must result in more harm than good for reasons which long experience has demonstrated to be well established.

In conclusion an electrical education must be continuous, whether obtained at the schools or by correspondence exercises. To this end the standard electrical periodicals and books should be persistently read. And it will not do to simply read one book on any given subject. Every writer has his points of weakness and individuality and it is only by comparative reading of several books on the same subject that clear and correct statements of principles and their explanations and applications can be arrived at.

ARMOUR INSTITUTE,
CHICAGO.

EFFECT OF CATHODE RAYS ON SALTS.

In No. 38 of the *Sitzungsberichte* of the Berlin Academy, Prof. Goldstein gives an account of a curious effect which the cathode rays exert on the color of certain salts. If potassium chloride be made to phosphoresce in a radiation tube, it quickly assumes a strong heliotrope shade, and eventually becomes bright violet. On heating, the color changes to blue, and at high temperatures the salt becomes white. The same series of color changes may be obtained with this decolorized salt, and also with naturally occurring potassium chloride or sylvine. Several haloid salts of the alkali metals were examined, and with the exception of cesium and rubidium chlorides all gave after-colors. The chlorides of barium and strontium gave no after-colors. In ordinary air the color disappears the more quickly the more soluble the salt. The color of lithium chloride fades almost immediately; the blue color of sodium chloride lasts about a day. In contact with water the salts at once lose their color. In a vacuum or in dry air the deep blue color of lithium chloride has now lasted for two months without apparent change. The color of potassium chloride gradually fades and completely disappears in about a week; the behavior of most of the salts is like that of potassium chloride. The cause of these phenomena is unknown. The salts were as pure as could be obtained. Electrodes of different materials gave the same results. The radiation-tubes contained, of course, a little mercury vapour; but none of the known compounds of mercury with the constituents of the salts have the colors above described. Chemical decomposition is unlikely, since the colored salt gradually changes into its original condition. The author inclines to the view that during phosphorescence the particles of the salt have been made to take up positions and motions differing from those of the unaltered substance, and that a physical modification of the salt has thus been brought about.

AN ELECTRODE SENSITIVE TO LIGHT.

In the *Zeitschrift für Physikalische Chemie*, H. Luggin describes a new form of electrode which he claims to be much more sensitive to light than any that has hitherto been made use of in previous investigations. Briefly, its essential features are as follows: A plate of platinum is coated with silver bromide and is then duplicated with a similarly coated platinum plate in an aqueous solution of bromide of potassium (decinormal). A quadrant electrometer of the usual type is employed in observing the rise of potential. Luggin states that in some of his experiments exposure to diffused daylight was sufficient to cause a rise of potential of 0.5 volt, thus demonstrating the great usefulness of this new form of electrode. When illuminated by any weak light it appears that this electrode shows a rise of potential which is uniform, and can be represented graphically in a system of co-ordinates by means of a straight line until a maximum is reached, after which it remains constant or may show a slight fall. The rate of increase of potential is much more marked when stronger light is employed, but for all that the maximum value attained is not higher. The rate of rise, however, is not directly proportional to the intensity of the impinging light, whilst it is also lowered by a previous exposure of the electrode to a powerful light. Continuous and intermittent lights of the same intensity do not appear to produce the same effect on the potential. These plates, though ingenious and likely to become exceedingly useful in certain investigations, do not remain constant as regards their sensitiveness, and even after long rests they show with the same sources of light very different increases of potential.

THE ELECTRICAL ENGINEER.

[INCORPORATED]

PUBLISHED EVERY WEDNESDAY AT

203 Broadway, New York.

Telephone: 1393 Cortlandt.

Cable Address: LENGINEER.

Geo. M. Phelps, President.

F. R. COLVIN, Treas. and Business Manager.

Edited by

T. COMMERFORD MARTIN AND JOSEPH WETZLER.
Associate Editor: GEORGE B. MULDAUR.New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue,
Boston, Mass.Western Editor and Manager, C. KAMMEYER, 1439 Monadnock Building, Chicago,
Ill.New York Representative, 203 Broadway, { W. F. HANES.
Philadelphia Representative, 916 Betz Building, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada, - - - - - per annum, \$3.00
Four or more Copies, in Clubs (each) - - - - - 2.50
Great Britain and other Foreign Countries within the Postal Union " - - - 5.00
Single Copies, - - - - - .10

[Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1893.]

EDITORIAL ANNOUNCEMENTS.

Addresses.—Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of THE ELECTRICAL ENGINEER. Communications for the attention of the editors should be addressed, EDITOR OF THE ELECTRICAL ENGINEER, 203 Broadway, New York City.

Communications suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.

VOL. XVIII. NEW YORK, DECEMBER 12, 1894. No. 345.

CONTENTS.

EDITORIALS:—

	PAGE
The Cost of Current	478
Overshot.....	479
Iron Armored Interior Conduits.....	479

ARTICLES:—

The Signal Corps of the U. S. Army; Instruction Work at Fort Riley, Kan. (Illustr.).....	GEORGE HELI GUY. 469
The Hens Storage Battery (Illustr.).....	472
Electrical Machinist Practice.—XIII. (Illustr.).....	J. F. HOBART. 473
Some Aspects of Electrical Education.—II. (Concluded.).....	W. M. STINE. 475
Direct Current Motor and Dynamo Design.—I. (Illustr.).....	G. A. DUNN. 481
Experiments on the Direct Production of Electricity from Coal and Combustible Gases (Illustr.).....	486

ELECTRIC TRANSPORTATION DEPARTMENT:—

Electric Street Railways in Detroit, Mich. (Illustr.).....	480
Electric Railway Mail Service in Cleveland, Ohio.....	480
Present and Prospective Development of Electric Tramways.....	480
A Roller Expanded Rail Bond (Illustr.).....	481
Electric Elevated Railways in Chicago.....	481
Chicago—St. Louis Electric Railway.....	481
A New Trolley Peril.....	481

NEWS AND NOTES:—

Luminescence of Glass due to Cathode Rays.....	476
Effect of Cathode Rays on Salts.....	477
An Electrode Sensitive to Light.....	477
New York Subway Commission.....	487

LETTERS TO THE EDITOR:—

Types.....	C. J. REED. 488
Automatic Electric Belt Shifters.....	C. L. N. 484
Reply to the Above (Illustr.).....	H. V. PARSELL, JR. 484
Incandescent Lamps—Efficiency vs. Life.....	C. A. DOUTRE. 484
Early Morning Telephone Tests.....	R. C. MATLOCK. 485

INVENTORS' RECORD:—

Classified Digest of U. S. Electrical Patents Issued Dec. 4, 1894.....	485
--	-----

SOCIETY AND CLUB NOTES:—

Brooklyn Electrical Society.....	487
----------------------------------	-----

LEGAL NOTES:—

Thomson Electric Welding Co vs. Two Rivers Mfg. Co.....	487
---	-----

PERSONAL:—

Dr. S. S. Wheeler.....	487
Mr. J. W. Godfrey.....	487
Sir John Pender.....	487

OBITUARY:—

Frederick R. Degenhardt.....	487
George H. Roe.....	487

TRADE NOTES AND NOVELTIES AND MECHANICAL DEPARTMENT:—

The Belknap Motor Co.—P. & B. Specialties.—New England Notes.—Western Notes.....	487
New Wainwright Water Tube Heater. (Illustr.)—McEwen Engines.—Railway Supplies Wanted.—Reorganization of the Thomson-Houston Electric Co. of New York.—Engine Proposals Wanted.....	488

THE COST OF CURRENT.

WHILE it is acknowledged that in point of convenience, safety, healthfulness and beauty the electric light is superior to every other kind of illumination, the fact cannot be gotten away from that if it is to supersede other methods of lighting it must be able to compete with them in price. It is true, of course, that a better price can be obtained for a better article whatever its nature may be; but on the other hand those who are able and willing to pay the better price may be but a small percentage of the consuming public. The manufacturing cost of current, or of light, must therefore always remain the dominant factor in the growth of the industry. In a lecture before the Royal Scottish Society of Arts on "Future Electrical Developments," Mr. Ferranti laid particular stress on the points above mentioned, and pointed out various directions in which, in his opinion, the present cost of supplying current could be reduced. Considering Mr. Ferranti's sanguine spirit, as shown by the projects carried out under his supervision in the past, we are somewhat surprised to be told by him that, "for the present, engineers must go on as they have already been going," and that cheap electricity is not a thing of the immediate future. He adds: "We will require the plant of the future to be four times as powerful as at present for the same money and this I do not think is a thing about the realization of which there is much doubt." Mr. Ferranti believes that we have reached the limit of economy in the steam engine and that the gas engine will assist greatly in bringing about the increased economy hoped for. On this we think all those who have studied the question will agree, but not that alone will suffice to bring about the desired end. The great thing still to be brought about in central station operation is the evening-up of the load diagram. The introduction of storage batteries has done much to bring about this desirable result in some cases, but the majority of lighting stations still suffer from the idleness of a large portion of their capacity for the larger part of the day. Mr. Ferranti cannot, of course, be ignorant of the value of the storage battery as a leveller of the load diagram; yet, strange to say, he does not mention it as a way out of the difficulty. The experience in many German central stations and in the few installed in the United States has put this question beyond the region of doubt and it now only remains to apply the remedy. We are always glad to come across conservative views of the much vaunted future of electricity, and we believe, with Mr. Ferranti, that, along with the progress of invention and discovery, the well qualified electrical engineer can do as much for the art as the inventor or investigator by studying out and applying economical methods of construction and operation.

ELECTRICITY ON THE NEW YORK ELEVATED ROADS.

THE inroads which the surface railways in New York City have been making upon the receipts of the elevated railroad companies during the past year were shown in the annual report of the latter, which indicated a falling off in passengers amounting to about 20 millions and in receipts to nearly a million dollars. In commenting on

this significant exhibit recently, we expressed our belief that the elevated roads could retrieve their lost ground and, still further, increase their previous receipts by the adoption of electricity as a motive power. We are glad to know that at a recent meeting of the Manhattan Railway Co. steps were taken to increase immediately the terminal facilities at the upper end of the road in Harlem, and to introduce other improvements. Mr. Russell Sage is even reported to have said that in time the elevated roads would give an ideal service with electricity and a double deck structure. With an under ground electric road in New York now practically assured there is indeed no other alternative left for the elevated roads.

With the increased comfort which cars propelled, heated and lighted by electricity will afford passengers, we believe that the only remaining objection to the elevated roads to be the necessity of climbing stairs to reach the level of the tracks. This objection could be easily overcome by the introduction of continuously operated inclined electric elevators, drawing their supply of power from the railway conductors. These elevators would practically require slight attention beyond the usual inspection. We suggest this method of attracting passengers to the elevated roads now rapidly nearing completion in Chicago. Experience in New York has demonstrated that many persons prefer to prolong the time of their journey considerably rather than subject themselves to the hardship of mounting flights of stairs not infrequently several stories high. If we are not greatly mistaken the officers of the New York elevated roads have in their pigeon holes all the data necessary for the construction and operation of an elevated system by electricity and Mr. Sage's remark, quoted above, is probably based on the information already in his possession. Electricity for the New York elevated roads is perhaps not so far off as some may think.

OVERSHOT.

AN entertaining periodical, whose *raison d'être* seems to be vituperation of the General Electric Company and "all that in them is," has somewhat overshot its target. In a recent issue it attributes to Mr. F. P. Fish, general counsel of the General Electric Company and of counsel for The American Bell Telephone Company, a positive statement that the appointment of Attorney General Olney was secured through the powerful influence exerted by the Bell people. No rational person would believe that Mr. Fish ever made such a statement. Not content with this the editor goes on:—

This unseemly boast of Mr. Fish's is now recalled by his recent utterances to personal friends in regard to the outcome of the Bate case, lately tried before the U. S. Supreme Court. He says there is no possible doubt but that the case will be decided in favor of the Bell Telephone and G. E. interests.

Does Mr. Fish know this? If so, how does he know it?

Of course Mr. Fish does not know it; but what should be said of the imputation upon the integrity of the Supreme Court, and the confusion as to the relations of the Attorney General and the Court, implied in the above extract?

A refutation of such charges seems hardly requisite, but Mr. Fish distinctly denies both. He says: "I absolutely deny that I ever said that Mr. Olney's appoint-

ment was obtained through the influence of the Bell company or people—it would have been a lie if I had said it—and I absolutely deny that I ever said, to personal friends or any one else, that there was no possible doubt that the Bate case would be decided in favor of the Bell Telephone and General Electric interests, or anything of the sort. Such a proposition would be ridiculous and silly."

Legitimate and well founded criticism is one thing,—and there have been many occasions for it in the history of the General Electric Company—, gratuitous detraction and insult are quite another thing.

IRON ARMORED INTERIOR CONDUITS.

IN our issue of September 26, we called attention to Supplement No. 2, issued by the New England Insurance Exchange in relation to electric light and power rules and requirements, in which the use of two conductors in iron armored conduit is approved. Efforts have been made to have the New York Board of Fire Underwriters recognize and approve of insulated iron conduits for interior electric lighting, and also to permit the use of twin conductors, or two standard wires, in iron armored conduits, and we are pleased to note that these efforts have at last been rewarded in the granting by the New York Board, of permission to use two separate conductors, or a twin conductor, of standard type, within the iron conduit. The introduction of two wires in a single conduit acts as a safeguard in that it can be carried out successfully only by employing the best types of insulated wires installed in the most careful manner, and to that extent therefore it has an additional claim to recognition. The phraseology, however, of the amendment, as printed and issued by the Board of Underwriters, appears to us somewhat peculiar. It reads as follows:

INTERIOR CONDUITS—

Rule 22.

c. Add to clause—

"Unless the said two separate conductors or twin conductor having an approved insulation, are enclosed in a complete, fully insulated, continuous iron conduit, and are in circuits installed as per table of Capacity of Wires (see Section 25), for currents not to exceed 100 Amperes."

RULE AS AMENDED.

Rule 22.

c. Must not be supplied with a twin conductor or two separate conductors, in a single tube, unless the said two separate conductors or twin conductor having an approved insulation, are enclosed in a complete, fully insulated, continuous iron conduit, and are in circuits installed as per table of Capacity of Wires (see Section 25), for currents not to exceed 100 Amperes.

The phraseology "a complete, fully insulated, continuous iron conduit" seems to us misleading, and under the wording of the clause a plain iron conduit system could be used in a great many instances, and the insulation test would prove that it was fully insulated. The wording should have been, and was probably intended to be, practically as follows: "A complete, fully insulated, continuous iron *armored* conduit." The difference between the wording of the two phrases may not be apparent except to an inexperienced eye, but nevertheless there is contained in the amendment, as passed, an ambiguity that ought not to be there. A plain iron system could be installed in a great many cases, and, under this special ruling of the Board, they would have to issue a certificate. We trust that the New York Board will be wise and progressive enough to do as other Boards have done, under their agreement with the International Association of Underwriters, and adopt the standard amendment as published in our issue of Sept. 26.

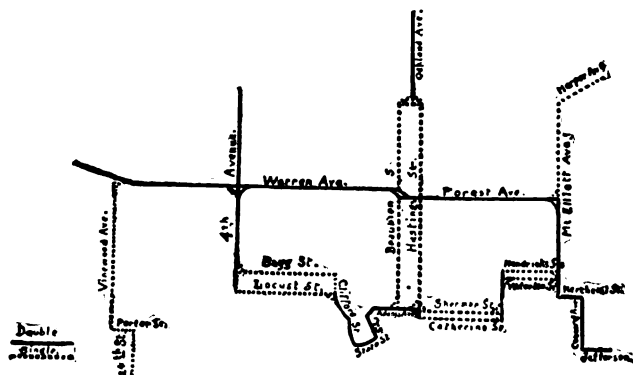
ELECTRIC TRANSPORTATION DEPARTMENT.

ELECTRIC STREET RAILWAYS IN DETROIT, MICH.

A despatch from Detroit to the *Cleveland Leader*, dated Dec. 4, gives the following account of the new electric railway work to be carried out in Detroit:

"The Common Council of this city to-night voted down a motion to reconsider its action of last week in voting to the Pack-Everett street car syndicate an ordinance providing for three-cent fares, and Mayor Pingree at once signed the ordinance. It is a big feather in Pingree's political cap, as he has been kept in office largely through his fight for three-cent fares. The new company will begin with a fight on their hands, as the old Citizens' Company, in which Al. Johnson, of Cleveland, is interested, claim exclusive rights in the streets and the Citizens' Company have notified the new concern that they will insist on their rights. The new company will be organized to-morrow with \$1,000,000 capital, Albert Pack to be president, Greene Pack, treasurer, and H. A. Everett, vice-president and general manager. It is announced that C. W. Wason, E. W. Moore, and George B. Pettengill, of Cleveland, will also be interested in the new concern, as well as Charles L. Pack and George W. Pack. Half of the capital stock will at once be paid in. The new company will force the fight with the Citizens' Company. They have already ordered rails and will at once begin work. An injunction to prevent these proceedings will probably be asked for and the matter will be fought out in the courts. Most of the people of the city are in favor of the Pack-Everett concern. They begin with forty miles of track and will ask for more lines."

The route of the new Detroit Railway Co., with all the changes



MAP OF THE NEW DETROIT RAILWAY SYSTEM.

which have been made, as passed by the common council is shown in the accompanying map, reproduced from the *Detroit Free Press*. With their forty miles of track the new company claim that they can accommodate a large percentage of the people of the city. The company will go to work immediately in a systematic manner, and will accomplish a great deal in short order. The work will be divided into departments. One department will take care of the equipment; another of the power house and a third of the labor in the streets. The power house will be located with a view to future extension and will be as nearly as possible at the centre of the system when the latter is complete. The track construction will be of the best. It is probable that 90 pound rail will be used, though the ordinance only requires 77½ pound.

ELECTRIC RAILWAY MAIL SERVICE IN CLEVELAND, OHIO.

An estimate of the cost of operating four mail cars on the lines of the Consolidated Street Railroad of Cleveland, Ohio, has been asked by Postmaster Anderson of that city. The postmaster states that the cars must be at least 15 feet long inside and equipped as the railway postal service cars are with side doors, mail bag racks and 100 distribution boxes. Each car will make six trips daily except Sundays when there will be two. The company furnish the motormen and conductors if the latter are deemed necessary.

Mr. Anderson has been working for several months to devise plans for improving the mail facilities enjoyed by the people in the outskirts of the city and much has been accomplished in that line. It has long been a pet scheme of the postmaster's to utilize the electric motors and thus secure a much greater dispatch of the mails.

PRESENT AND PROSPECTIVE DEVELOPMENT OF ELECTRIC TRAMWAYS.

At the meeting of the American Society of Mechanical Engineers, held in this city last week, Mr. C. J. Field read an interesting paper on the above subject. Starting with a brief review of electric railway work, the author brought up in turn its several sub-divisions with a view to showing the development which has taken place in each. The road bed, track bonding, line construction, underground conduits, cars and their equipments, power houses and car houses were all touched upon and the best present practice in each case contrasted with that of earlier years.

Operating expenses and cost of equipment, however, formed perhaps the most important part of the paper. The old horse-car road in large cities, the author said, operated at a total cost of from eighteen to twenty-five cents per car mile. One car mile is taken as the standard for operating expenses in our tramway service. The heaviest item in this operating expense was the question of power—that is, the care, maintenance, feeding, and depreciation of the horses. The average life of a horse on a well-operated tramway road is five to six years, and the number of horses required per car from eight to eleven, according to conditions and requirements. The cost of this power service was from eight to eleven cents per car mile. This is where the electric road has made its heaviest gains in the reduction of operating expenses. This item is reduced in power service to-day to a cost, under general conditions, ranging from one to one and a half cents per car mile. The relative proportion of operating expenses to earnings in the horse-railway service was from seventy to eighty per cent. In electric service we have a considerable increase in gross earnings over our old horse line, which increase runs from twenty-five to fifty, and even one hundred per cent. in some cases; the operating expenses being forty to sixty per cent. of the gross earnings. In this operating expense, are included all the operating expenses of the road other than the fixed charges.

The cost of building and equipping an electric road is considerable. The last year or two has reduced this item to a considerable extent, and has not only reduced the cost, but shows a great deal better equipment, and one which is going to show a much smaller depreciation than we had a few years ago. The standard price four years ago for an equipment and installation of two fifteen-horse-power motors was \$3,000 to \$3,500. The price to-day for two twenty-five-horse-power motors, which are greatly superior to the former ones, is under \$1,000. This gives a total cost of a motor car, including car body, truck, motors, etc., of approximately \$2,200.

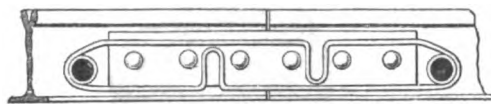
A single mile of road-bed construction, with ninety-pound girder rail, exclusive of any new pavement, but including taking up of the old track and replacing of old pavement, costs about \$7,500 per mile of single track. This makes no allowance for special work. Overhead-line construction for one mile of double track, with iron poles, feeders, etc., may be placed at \$4,000 to \$5,000 per mile; with wooden poles, about \$3,000 or \$4,000 per mile. Steam and electric plant for direct-connected vertical compound condensing plant—for steam plant, \$50 to \$55 per horse power, and the electrical, \$20 to \$25 per horse power, making a total for steam and electric plant, \$70 to \$80 per horse power. As a general summary, we have for the total cost of the equipment of the electric tramway—that is, the rebuilding of an old horse road—including power plant complete, buildings, car house, cars, equipment, track and overhead construction, \$20,000 to \$25,000 per mile of single track, according to the varying conditions and requirements of different cases.

In conclusion the author stated his belief that electric tramways have more than met all the requirements, expectations, and agreements of even the most enthusiastic advocates during their introduction. The future possibilities of the tramway, not only for city and suburban traffic, but also to enter into competition for a large share of the steam railway service are great. The speed and power obtainable is only limited by the conditions and local requirements of this service. Theoretically, the speed is only limited by the resistance of the air. The exact line which this development is going to take is hard to determine; but the author believes that for a number of years to come it will be a continuance of the present lines, with improvements in the general detail of construction.

Up to the present time in this service, development has been with direct or continuous current. There was no question but that, with the improvements and modifications which are being made in alternating current apparatus, we may expect its introduction on the tramway service, especially for long-distance work. In all this work the mechanical engineer has played and will play an important part, and the combined mechanical and electrical engineer has been, and will be, largely identified with the development of this line of work.

A ROLLER EXPANDED RAIL BOND.

THE accompanying illustration represents a novel rail bond, the design of Mr. F. F. Robinson who brought it to the attention of the London Institution of Electrical Engineers at their last meeting. The terminals consist of short metal tubes expanded into the webs of rails in the usual manner employed by boiler-makers to secure tubes in tube-plates. This method is claimed to



ROLLER EXPANDED RAIL BOND.

possess the following advantages:—1. *Cheapness*, as ordinary wrought-iron tube may be used, sawn into short lengths, and oxide removed by grinding or otherwise. Thus no turning or expensive machining is required. 2. Large and efficient contact area, the surfaces of holes and tubes being quite bright. Mr. Yarrow has proved by experiment that the holding-power of a 2-inch tube, expanded in the ordinary way, is at least 8 tons, and that the effect of "rolling" is not merely to bring the two surfaces in contact, but to cause pressure one against the other.

ELECTRIC ELEVATED RAILWAYS IN CHICAGO.

Details for the building of the joint loop for the four elevated railroads in Chicago have been completed and as soon as the consent of the required number of property owners is secured the work of construction will begin. The loop will run north on Wabash avenue from Harrison street to Lake street, west on Lake street to Market street, where connection will be made with the present structure of the Lake street elevated, running as far south as Madison street, the line being extended south on Market street to Van Buren street, east on Van Buren street to Pacific avenue, south on Pacific avenue to Harrison street, and east on Harrison street to Wabash avenue.

A contract has, it is asserted, been signed by Charles T. Yerkes for the complete equipment of the Lake Street line with electricity. This contract provides for a sufficient number of electric motors for all the trains to be run on the line and for a power plant, including engines, boilers, and dynamos, with which to generate the current. More than this, the Northwestern Elevated, which is to be extended across the Chicago River and connected with the loop, is to be operated entirely by electricity. The Alley Elevated has conditionally agreed to a substitution of electricity for steam. The managers of that company say, at present the road is unable to stand the expense of such a substitution. D. H. Louderback, President of the Northwestern Elevated, and Mr. Yerkes' representative in the loop plan, has said to the Alley Elevated people that he will furnish them with electric locomotives for propelling trains around the loop. By this plan the Alley road would run its trains by steam north as far as Harrison street, where electric motors will be substituted for steam engines for the pull around the loop, the engine again taking the place of the motor for the run south from Harrison street.

THE CHICAGO-ST. LOUIS ELECTRIC RAILWAY AGAIN HEARD FROM.

THE St. Louis *Chronicle* prints an interview with Dr. Wellington Adams, in which he asserts that "the Chicago and St. Louis Electric Road will most certainly be built, but not until after a revival in business."

"Already \$8,000,000 of the \$10,000,000 worth of bonds have been placed," Dr. Adams continues, "and it will not be much trouble to place the remainder. The grading and securing the right of way is going steadily on. The distance between Chicago and St. Louis will be shortened about 35 miles, and the time reduced from 10 and 12 hours to 3 and 4. Fast mails and express will then arrive, and depart almost every hour from St. Louis."

A NEW TROLLEY PENAL.

A bright Philadelphia *Item* young man tells of the hair-breadth escape of an unhappy wretch whose neck was encircled by a trolley cord and who was lifted from his feet when the trolley ran off the wire. "Fortunately," adds the bright Philadelphia *Item* young man, "only for an instant did he hang thus. The conductor quickly loosened the rope and let the unfortunate man out of his precarious position. For the time he was almost strangled and several leaders in his neck were badly strained."

MISCELLANEOUS.

DIRECT CURRENT MOTOR AND DYNAMO DESIGN.¹—I.

BY GANO S. DUNN.

I wish to refer to-night to several features of direct current motor and generator design, and not to pretend to cover the whole subject, and I trust this will not be without interest to you.

The first point I wish to bring out is how very imperfect are our means of rating electrical machinery. We have good means of rating other machinery, but we do not have good means of rating electrical machinery. The steam engine is rated by the diameter of its cylinder and length of stroke and its speed. It is not sold by horse power, because an engine which could develop 100 horse power at $\frac{1}{2}$ cut-off would develop 200 horse power at $\frac{1}{4}$ cut-off. In electricity the problem is similar, but we have no way of rating motors by the diameter of cylinder and length of stroke as they have in steam engine practice, and we are continually suffering on this account. Water wheels are not sold by horse power. You do not buy a 50 horse power water wheel; you buy a 28 inch water wheel and run it at so many feet head, and then figure out how much power you can get from it, and if it is not enough, you buy a 30-inch wheel.

The limits of loading an electric motor are really two only; namely, you have reached the load of a motor when it begins to heat so much that it is dangerous to continue to run it, and you have also reached its limit of load when it sparks so badly that if you run it longer it will destroy its commutator. There are builders to day who build a motor which will have a very high efficiency at one-third load, but which will spark if it is overloaded, and there are other makers who build a machine which

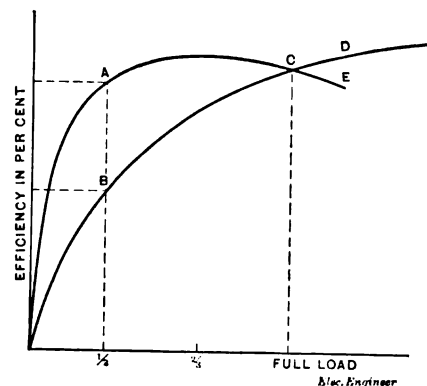


FIG. 1.

has not a high efficiency at light loads, but which will stand three and four times normal load without sparking. Now both of those motors are listed in the catalogues, are charged for and are known as, let us say, 10 horse power motors.

If you buy a 10 horse power motor without knowing something about these facts—it is possible that you will be very much disappointed. If it is agreed that we should call a motor that runs at about 6 horse power, but is capable of running at 10 horse power continuously without dangerous overheating, but will never be called upon for more than 10 horse power,—if we should agree to call such a motor a 10 horse power motor, very well. But then we ought to call the motor which is used in crane service, which is called upon for 30 or 40 horse power for periods of ten minutes at intervals, something more than, or different from, 10 horse power, and the builder ought not to be obliged to make one motor fill one user's requirements and another user's requirements, when their requirements differ so much. Suppose we sell two 10 horse power motors to ordinary customers. We may hear a report from one of them that this motor is not a good motor; it does not give 85 per cent. efficiency at one-third load. While the other one will say this motor is not a good motor; it sparks very badly when loaded to 300 per cent. of its normal load for a few moments. In view of these facts horse power is not a fair way to rate machines.

The lines between these kinds of motors are not so distinctly drawn as I have pointed out, but for the purposes of illustration I have shown here two curves, A and B, Fig. 1. A is the curve of a motor of the kind first mentioned above. It is expected to run at 6 horse power average, can give 10 horse power all day long if you require it, but must not give any more, and has a very high efficiency at light loads. Such a motor is an ordinary power motor for running a printing or machine shop. The other motor, whose curve is shown at B, is a motor whose

1. A lecture delivered before the New York Electrical Society November 27, 1894.

efficiency at light loads is very low; it is not much more than half of the former. But its efficiency at full load is exactly equal, and at overload is even higher than this other motor. Motor B is much superior for its work to the former motor because whenever it does run it runs at three times its rated load, and motor A, whenever it runs, as I will show later, runs at only one-third its rated load. Put motor B on the load that A is built for, and A on the load that B is built for, which is what you are likely to do, and you will not secure the best results.

This A curve machine is the type of ordinary power motor running machinery by a belt. The B curve machine is a type of railway motor or motor for operating cranes, or for other intermittent and very heavy work. These two conditions affect the design of a motor very much, and the way they affect it is this: At the point C both motors have the same efficiency. That means that the losses in both motors are equal. But why, then, does curve A differ from B? The difference is in the distribution of the losses. The losses in a motor are of two kinds, fixed and variable. The fixed losses are the losses due to field current, hystere-

meter that measures the current taken. Now if this were a 10 horse power motor and ran ten hours per day, it ought to have 100 horse power hours for every day it runs. The meter readings were taken and the average was between 25 and 30 per cent. of the power that the motor could have given according to what was stamped on its name plate. Now if we build a motor with the



FIG. 3.

kind of an efficiency curve B, and use it for a purpose such as I have just spoken of, where a motor averages only one-third load, it is practically equivalent to taking a motor of only one-half the efficiency.

Another thing with regard to the rating of motors is the speed. Other things being equal a high speed motor is cheaper to build than a low speed one. It is a smaller machine operated at greater activity. If brought to the same speed it would have less power. A motor, to be compared carefully, ought to have these points determined:

1. At what portion of its load does it commence to spark?
2. At what portion of its load will its temperature rise abnormally?
3. What is its efficiency at various points?
4. At what speed does it run?

Reduce all these things to a common basis and you have a fair method of comparing motors.

Too much importance has heretofore been attached to full load efficiencies. Motor engineers boast that their machines have 90 per cent. efficiency and some other maker's machines have only 88 per cent. efficiency. They speak of the highest efficiency that the machine is capable of, or of the efficiency of which they are most proud. Now that may not be the efficiency which the customer wants to know. There are many cases where a motor of 85 per cent. efficiency would take less current to run a printing office than a motor of 90 per cent. efficiency, for this reason: At point D, Fig. 1 is a motor of 90 per cent. efficiency. But the printing office runs at only about one-third the power of its motor, and would therefore realize the efficiency at B; whereas at point E here is a motor which has 85 per cent. efficiency and if the printer bought that he would realize the efficiency at A which is much higher than that at B.

The next feature to which I wish to call your attention is the most recent methods of winding. I cannot go into this more than slightly, but it might be well to give some idea of what they are. In winding bi-polar machines, windings are all on the same principle; they are two-circuit. As the current leaves the brush, in diagram A Fig. 2¹ half goes down one side of the armature and half down the other and joins the bottom brush and goes out. Now there is not much room for modifications in that winding. It can be made ring or drum, and that is practically all. But when we come to the multi-polar machines there is a great variety of windings which we can use. If we imagine B, Fig. 2, to be a

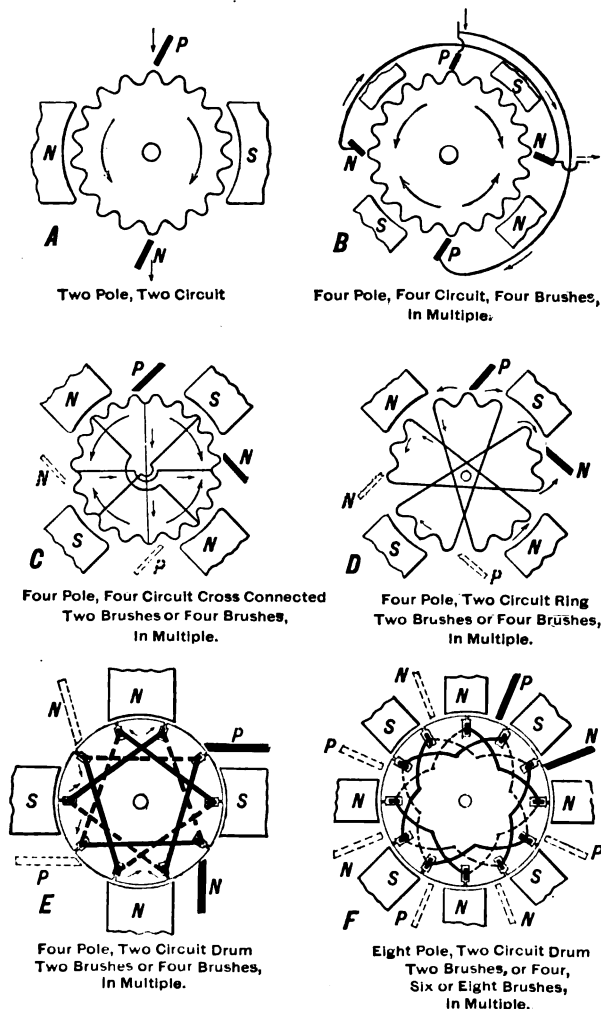


FIG. 2.

sis and eddy currents, brush friction and bearing friction. The variable losses are the losses due to armature resistance and the losses due to commutation. Now motor A is a machine with a small magnetic circuit using comparatively few lines of force. Therefore the wire that is wound around the magnetic circuit to keep it excited need not be very great and therefore will take but a small amount of current to energize it. The iron in the armature will be small in quantity, and therefore the hysteresis and eddy currents will be low, and the bearings will be rather light because this motor is never called upon for more than rated load. Therefore the fixed losses are light. The variable losses, such as armature resistance and commutation losses, may be high in this machine without detriment. The reverse of these conditions is true in machine B. These points are of great importance but they have not received attention.

As a result of tests made on about 200 power motors, at the instance of Mr. H. L. Lufkin of the Crocker-Wheeler Co., it was found that these 200 motors on actual commercial circuits did not average one-third of their load. The readings were taken in this manner. It is customary wherever a motor is installed to put in a

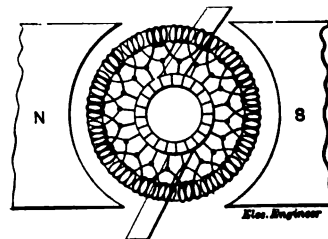


FIG. 4.

4-pole machine, with an armature a ring in which the wire is wound around and around. Then the current may be taken off this armature by brushes P, N, P, N. These are the field magnets of alternate polarity and each field-magnet generates a portion of

2. From "The Practical Management of Dynamos and Motors," by F. B. Crocker & S. S. Wheeler.

the total current. This is called 4-circuit, because there are four circuits from which the current is collected in the armature.

The earliest multipolar machines were wound in this fashion, but there are some objections to it. If one pole is stronger than its neighbor, then when it sends its current to be collected it will be under greater pressure than the one coming from the other pole and if there is sufficient difference will neutralize it and send a reversed current through its winding. This causes heating, diminishes output and reduces the efficiency of the machine. Now it is very easy for one magnet to become weaker than another one in an actual machine. Suppose, for instance, that the bearings of the machine wear. The armature will settle down and will be nearer the bottom magnets than it will be to the top and they will make stronger currents than the top ones will. Then again, if the windings on the magnets are not very carefully made and one has a few more turns of wire than the other, it will be stronger, and there are a great many ways that the effect of inequality of electromotive forces generated under the poles will produce very bad results.

To overcome this, windings were invented which are called 2-circuit windings. The object of the 2-circuit winding is that the wire shown in D, Fig. 2, instead of going along always under the weak pole, between every section cuts across and goes under a strong pole and comes back, and the winding under the strong pole cuts across every other section to the weak so that by the time the brush is reached, the windings have each had acting upon them both the weak and strong poles, and the result has been to make equal electromotive forces and produce no trouble.

In actual winding these connections are not made on the armature in this form of two circuit winding but are made inside the commutator. This commutator is of the kind shown in Fig. 3. Every bar is connected to the bar directly opposite to it by a bird-wing form of connector. The connector is shaped in the following way: It starts down, goes over in the form of a bird-wing, goes inside about an inch and after it has reached the under layer of windings it makes the rest of its circuit until it gets down to the bottom. The armature is wound the same as a 4 circuit armature, but when its ends are put into the commutator, these cross connectors have the effect of making the alternate poles generate part of the electromotive force, as shown in the diagram. The armature I have described is but one kind of a two-circuit armature, but there are other kinds that are used just about as much. The other kind of armature is not wound in ring form but is like that shown at E in Fig. 2. Now the armature I have just described was wound as a coil, which was connected to another on the other side. There will be no short circuiting due to unequal voltages. (A model of this kind of an armature was exhibited). I will not describe farther the 2-circuit windings, since they are all on the same principle.

There is another advantage in the 2-circuit winding besides stopping the interaction of parts of the armature against itself; and that is, that for very high voltage machines if we had a 4-circuit armature as previously described in B, Fig. 2, the wire under each pole would have to generate full voltage. In a 500 volt machine, each pole would have to generate 500 volts, so that the little current it contributed would be at the same pressure as the other current. That necessitates fine wire. If there are only two circuits each pole contributes only half the voltage and the wire may be of twice the size, which is a very important consideration. When we get into very large machines, however, then the wire gets too big for us to handle in two-circuit machines and we go back to the 4-circuit windings.

The next form of winding that I wish to describe is one in use by the General Electric Co. and known as a double winding. The reason for a double winding is this: It is a rule among electricians that the voltage between any two bars of the commutator, must not be greater than, say, 20 volts. If it is much greater in a large machine, any little accident—a piece of carbon—would make a flash, and, once started, the whole commutator would blaze and there would be a short circuit and great trouble. To keep that down the voltage between the bars must be kept down low.

The voltage generated by a machine is proportional to the size of the magnets and the number of the windings. Now as the magnets get large the windings need be fewer in order to generate the same voltage. As our machines get larger and our magnets get larger we only need a few turns of the heavy conductors on the armature to give us, say, 110 volts for lighting. We soon reach the point where, say, 10 turns on the armature would be enough to give us 110 volts. That would give us 10 sections to our commutator, and as half the sections are on one side and half on the other, that would give us only five sections of the commutator among which to distribute 110 volts and that would be more than our limit. Now what are we to do? We cannot increase the number of turns because we would get more voltage than we wanted. We cannot decrease the size of the magnets because then we would have sparking and armature reaction and other troubles. There are two things for us to do; one is, to use the multipolar machines, which have a number of small magnets each contributing to the total current, or to use the form of winding shown in Fig. 4. Now in this diagram there are ten coils and ten commutator bars belonging to each winding. When we use the windings in conjunction

we have the voltage due to ten coils and the commutator bars due to twenty, and that is achieved in this manner. The windings are wound just as if they belonged to two different machines. One winding is entirely disconnected from the other and it generates, say, its 110 volts with its few commutator bars,—too few to be used by itself. The other winding is entirely separate and it generates its 110 volts with few commutator bars—too few to be used by itself. But when we put these two windings together, then we have still 110 volts, but we have double the current, because each of the windings contributes some, and we have double the number of commutator bars. Now that is in reality just like two dynamos. The brushes are made so wide that they cover at least two of the commutator bars, so that each winding is free to contribute its share of the current, no matter what the position of the armature is. We have shown this for a bi-polar machine. But if we go into multipolar machines we will soon reach a size where we are again face to face with it, and we would have to increase our poles and would soon catch up with this difficulty again, and this method of double winding is an excellent one for overcoming it. It has also the advantage that the collection at the brush is better.

LETTERS TO THE EDITOR.

TERMS.

IN a recent number of *The Chemical News* an able and well known chemist describes an electrical furnace. In the description we find the following sentence: "Connected to the furnace is a small plant of special construction and capable of evolving a voltage of 100° intensity, or can be readily arranged for amperical value, as required."

It is not our purpose to hold the chemist responsible for his odd phraseology in electrical matters. Unique as the above sentences may appear it is really no more ridiculous than is the single word "voltage" standing by itself on a pedestal of its own.

If an electrician were to say in regard to an experiment that "the voltage ran up to three thousand and the amperage to three hundred," he would not be accused of saying anything particularly funny. But if he were to say in regard to a trip from New York to Philadelphia "the yardage ran up to 170,000, the hourage to two and a half and the dollarage to two-forty and on the return trip a launch was used for footical purposes," he would be liable to the accusation either of insanity or of trying to perpetrate an A. I. E. E. planked-shad speech. The two sentences, however, when weighed in the balance are found to be etymologically about equal.

There seems to be no department of human knowledge except the science that deals with electrical energy, in which the names of measurable objects or subjects are derived from the names of their measuring units. We never speak of the temperature of a body as its *degreage*; the heat of a body as its *calorigage*; of time as *secondage*, *minutage*, *hourage*, *dayage*, *weekage*, *monthage* or *yearage*; of distance as *inchage*, *footage*, *yardage*, *rodage*, *mileage*; of volume as *pintage*, *quartage*, *peckage*, *bushelage*, *gallonage*, *barrelage*; of surface as *square-footage*, etc.; of weight as *grainage*, *ounceage*, *poundage*, *kiloage*; of money as *centage* or *dollarage*; of angles as *degreage* or *arcage*. Why then do electricians speak of electro-motive force as "voltage," of current as "amperage" and "ampage," of resistance as "ohmage"? How long will it be before we shall come to *henriage*, *mhage*, *wattage*, *coulombage*, *faradage*? Nay, this is not all. The "electrician" is nothing if not an inventor. Not content with compassing his own proper sphere of electricity with his evil genius, he has boldly entered the domain of the land-measurer and presented him with a new machine called "*circular-mileage*," a brief and simple substitute for the cumbersome word "area."

It is frequently said that electricity travels very fast. It seems to have traveled so rapidly of late years that it has had no time to put on clothes, but has been content to dress in whatever epithets chanced to be thrown at it that could be caught on the fly. Is it not a good time now for a pause in this free coinage of synonyms?

If it is necessary to have a shorter name for electro-motive force, why not call it *electrance* or *motance*? Or one of these terms could be used for electromotive force and the other for counter electromotive force. They have to recommend them that they are at least in form and origin analogous to the names of other similar subjects, such as distance, resistance, reluctance, impedance, reactance, etc. For magnetomotive force we could use *magnetance*.

If "current" is not a good enough word to express flow of electrical energy, let us use *fluance* or *currence* rather than "amperage" or "ampage." But what objection is there to the word "current," and what is to be gained by multiplying synonyms? We are beginning to hear of "wattless E. M. F." Why

1. *Fide*, Webster's Dictionary.

would not *powerless* do as well? How long will it be at the present rate of progress (?) before we hear of things that are *wattful, ohmful, ohmless, voltful, henriless, coulombless and amperable*?

When there is real necessity for coining a new word, why is it not as easy to order one properly born as to have it from its mother's womb untimely ripped? CHAS. J. REED.

PHILADELPHIA, PA.

AUTOMATIC ELECTRIC BELT SHIFTERS.

Can you or any of your readers give me any information in regard to an automatic, electrical belt shipping device to be attached to a power pump run by a motor?

We have a power pump with tight and loose pulley belted to an electric motor. We want some device by which the belt may be shipped automatically from the tight to the loose and from the loose to the tight pulley. The motion to be regulated by the rise or fall of the water in a tank on the top of the building.

HOLYOKE, MASS.

C. L. N.

To shift a belt both ways there are several methods, mechanical and electrical. Although only electrical methods are called for I give the following, Fig. 1, as it is so simple. This is the same

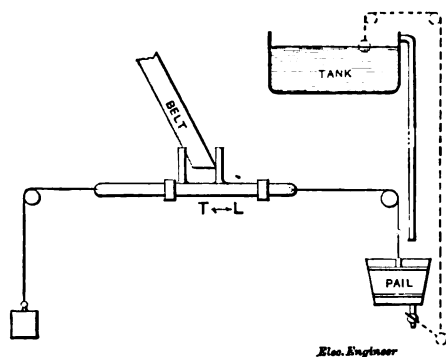


FIG. 1.

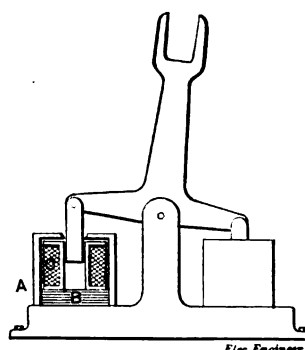


FIG. 2.

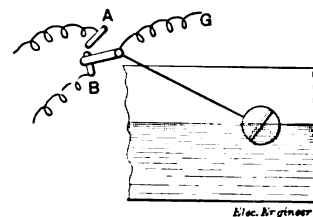


FIG. 3.

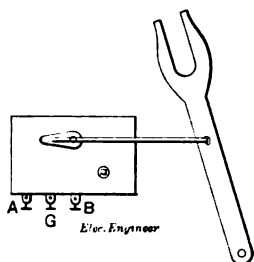


FIG. 4.

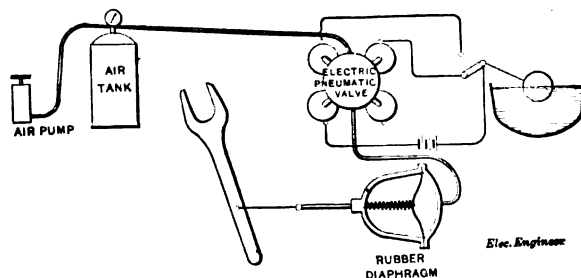


FIG. 5.

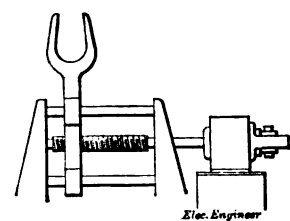


FIG. 6.

arrangement that is used with windmills. The belt is kept on the tight pulley by the weight shown. When the tank is full water comes down the small overflow pipe and fills the pail, pulls the belt over and the pump stops. After the overflow ceases the pail is emptied through a pet cock at the bottom; the weight then starts the pump. The time that the pump is stopped is regulated by the opening of the pet cock.

In case of a sudden fall of water it would be desirable to start the pump quicker than the pet cock is set for. This is accomplished by the attachment shown in dotted lines; when the water falls a float in the tank raises, by a chain, the weighted end of the pet cock handle, opening the cock and emptying the pail quickly. As the water rises, the weighted valve closes against a set screw which gives its normal opening. The fall in the tank before this device operates is regulated by the amount of slack chain between float and weight. It might be an improvement to have the pet cock stationary and connect it to the bottom of the pail by a rubber tube. Among electrical contrivances there is probably nothing very simple that would take but little current and be reliable, although the following arrangement, Fig. 2, might answer the purpose. It is simply a belt shifter operated by two iron clad solenoids. The exterior shell A screws onto the part B and thus holds in the coil C.

It is intended that the core should touch B when drawn in. This and all following arrangements require a double contact connected to a float in the tank, a float of this kind is listed in catalogues of dealers in electrical goods. Or it can be a simple two-point switch on the float stem, Fig. 3. The sketch Fig. 4

shows a box containing a strong clockwork which is controlled electrically so as to cause the crank shown in front to make a half revolution at each release of the clock. It is the same mechanism that is used to open and close furnace dampers.

Fig. 5 shows an adaptation of the Johnson system of control in which the electricity controls the admission of compressed air to and from a diaphragm which moves the shifter.

The last device which I will mention consists of a reversible electric motor which will move the shifter either way by a screw or other speed reducing mechanism. It requires in addition to what is shown, a reversing switch at the float, and a cut-off switch and brake on the motor so as to stop it quickly at the end of the shifter stroke. A suitably controlled, non-reversing motor, Fig. 6, could also be used instead of the clockwork shown in Fig. 4.

Although but a few of the possible devices have been given, yet I think they may suggest to your correspondent a solution which will be applicable to the case in question.

HENRY V. PARSELL, JR.

NEW YORK CITY.

INCANDESCENT LAMPS.—EFFICIENCY vs. LIFE.

MR. EDISON'S comment on selling light instead of current, as you say, is worthy of the fullest consideration. There are a great many central station managers who do not fully appreciate what

is meant by a high efficiency lamp, and do not adopt it, for they only look at it in the light of reducing their customers' bills and increasing the cost of renewals. Too much weight has been given to the cost of renewals, and not enough attention paid to the great waste of energy due to the low efficiency lamp. Here, the practice is to allow the lamps to become black from disintegration of the carbon filament, and are kept in circuit until they die a natural death. In the meantime the lamp is (using Mr. Edison's expression) "chewing up current" and giving the consumer about one-quarter the light which he reasonably expects, as he is paying just as much as he did when the lamp was giving the rated 16 C. P.

It is a short sighted policy to keep lamps burning too long. I think lamps might be forced considerably higher than is customary, of course, at the expense of their life and the renewal account, but the central station will gain as well as the customer. The former will be able to increase its output in lights, and the latter will get a better light. Adopt a high efficiency lamp and then charge for light (not current) and a marked improvement is sure to follow. By doing so the central station can give a better and cheaper light, increase its yearly dividends by increased business due to the reduction in price and better quality of light, and also increase its capacity for lights due to the change from low to high efficiency lamps.

When the C. P. commences to diminish and it is noticeable, it is good policy to break it and not let it burn out as is the practice of many. Of course, local conditions have yet to be considered; if water is the source of power and current is cheap the low

efficiency lamp does not cut the same figure as it does where coal costs from \$2.50 to \$4.50 per ton.

In regard to the rumor that a large consignment of German lamps are on their way to the States, I may say that we have had experience with German lamps here in Canada, which, to say the least, was anything but encouraging. I will cite one case in particular. We wired a warehouse for some 100 odd lights and sent 84 to be installed; of these, 66 were returned; about 13 burned out immediately the current was turned on and the remainder were all faulty. The corpus delicti was found upon examination to be an open circuit in the majority of the lamps, due to using too strong a fluxing fluid which had corroded the fine wires to such an extent that they had broken off or were completely eaten away.

In justice to German lamp makers let me state that the lamp in question was a poor, cheap article, and could not be taken as a sample of German workmanship. As the duty is the same in Canada as it is in the States I do not see how the Germans can send an A 1 lamp to the States and pay the duty and expect to compete with lamps of American make. They could not do it in Canada and I doubt very much if they can do it in the States.

C. A. DOUTRE.

MONTREAL, QUE.

EARLY MORNING TELEPHONE TESTS.

In your issue of November 28, Mr. J. W. Manson has an article on "The Early Morning Test in Telephone Offices" showing a method whereby time is saved and the lines are all tested when the men come on duty.

It does not seem to me that this mechanical test should be applied to line and instrument. For the operator to merely know that his test shows the line open or closed does not seem to be the test we desire, and I am a firm believer that the best test that can be made is to call the subscriber to his instrument and have him give the usual "ring" back. This tells us whether his line is in working order and also whether or not his instrument is working satisfactorily.

To merely ascertain whether the line is open or closed tells us nothing and gives us no information relative to the working of his instrument, or whether he is satisfied with its working. I believe it good policy to give the patrons a chance to speak for themselves and not depend too much on mechanical tests. I do not think that employees should be kept idle waiting for the test records and I have yet to see the exchange where there is not something to keep the men busy.

There is no reason why every business telephone should not and cannot be tested by at least 7.45 in the morning and in the majority of exchanges I believe they are. Residence telephones can be tested at a later hour if so desired. At this exchange, our test records are always in the hands of the Chief Operator at 8 A. M. and trouble slips are made out as fast as the trouble shows itself.

I think a little attention to this work on the part of the operators facilitates the test and does not make it a burden to any one and we derive the best results from a personal test with the subscriber or his employee and this cannot come from a mechanical test.

The more attention shown telephone patrons the better are the results and harmony and a good working exchange must follow.

ROBT. C. MATLOCK,

Mgr. Central Union Telephone Co.

CEDAR RAPIDS, IOWA.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED DECEMBER 4, 1894.

Alarms and Signals:—

Electric Railway Signaling, W. Daves, Jersey City, N. J., 530,098. Filed May 24, 1894.

An automatic electric system for street railways.

Signal Apparatus, C. E. Ongley, New York, 530,123. Filed Feb. 17, 1894.

Provides means whereby whistle signals can be sounded automatically upon boats in such a manner as to give information concerning the point of the compass towards which the boat is moving.

Signaling Apparatus, B. J. Noyes, Boston, Mass., 530,238. Filed Feb. 18, 1890.

A police signal system in which the signals sent from the signal boxes are received at the central station and all the wagon calls are received directly at the wagon house.

Electric Bell, E. G. Worley, New York, 530,253. Filed June 30, 1894.

Bilge-Water Alarm, C. Upton, Salem, Mass., 530,368. Filed Feb. 1, 1894.

Burglar Alarm for Safes, J. W. Gilstrap, Rolla & W. D. Gilstrap, Racine, Mo., 530,411. Filed Apr. 24, 1894.

Burglar Alarm, J. H. Lowe, Neosho, Mo., 530,434. Filed July 20, 1894.

Conductors, Conducts, and Insulators:—

Insulator for Electric Conductors, J. H. Croeskey and J. Locke, Pittsburg, Pa., 530,599. Filed Sept. 28, 1894.

Claim 1 follows:—

An insulated conductor of electricity consisting of a metallic conductor covered with a non-metallic mineral and embedded in glass.

Distribution:—

Electric Conversion System, L. Gutmann, Pittsburg, Pa., 530,178. Filed Dec. 23, 1891.

Has for its object to supply to alternating and constant current translating devices electrical energy derived from a source of alternating current.

System of Electrical Distribution with Storage Batteries, E. Kuchenmelter, Berlin, Germany, 530,482. Filed Nov. 25, 1892.

Employs a storage battery divided into uniform sections and having one of the sections connected permanently across the external circuit, and means for connecting the remaining sections in series with the first or in parallel with it.

Dynamos and Motors:—

Brush for Dynamo Electric Machines, P. J. C. Carron, Pont de Clair-Isère, France, 530,068. Filed Feb. 10, 1894.

Consists of wire gauze impregnated with plumbago and an adhesive substance.

Method of and Means for Operating and Controlling Electromotors, C. Moderegger, Vienna, Austria-Hungary, 530,114. Filed Dec. 18, 1893.

The method consists in passing a current through the motor and automatically switching a current neutralizing resistance into circuit after a determined period.

Alternating Current Motor and Method of Operating Same, L. Gutmann, Pittsburg, Pa., 530,177. Filed Oct. 30, 1899.

The invention consists in producing or inducing by means of a single energizing current in one conductor polyphased currents in another conductor, and in consequence a resultant rotary magnetic field.

Dynamo Regulator, J. Van Vleck, New York, 530,465. Filed Oct. 8, 1894.

Consists of two series of contact plates so disposed that the plates of one series are opposite the intervals of the other, resistances between the successive plates of each series and a contact piece so constructed as to bridge two plates of one series while bearing upon the other.

Alternating Electric Motor, L. Gutmann, Pittsburg, Pa., 530,177. Filed Dec. 23, 1891.

A self starting alternating current motor for heavy work which may be connected to and operated on existing single phase alternating current distributing circuits.

Galvanic and Thermo-Electric Batteries:—

Primary Battery, C. W. De Mott, New York, 530,290. Filed Dec. 7, 1893.

Employs a copper electrode having parallel slits and strips between them bent out of the plane of the rest of the tube to provide circulating passages for the solution without lessening the surface area of the electrode.

Battery Connection, W. S. Doe, Brooklyn, N. Y., 530,401. Filed Aug. 27, 1894.

Primary Battery, C. J. Hubbell, New York, 530,495. Filed Apl. 30, 1894.

Employs a reservoir secured above the porous cup, containing a receiving chamber for the fumes and another for an absorbent agent.

Lamps and Apparatuses:—

Electric Light Fixture, H. Horn, Philadelphia, Pa., 530,343. Filed May 24, 1894.

Measurement:—

Electrometer, E. Weston, Newark, N. J., 530,145. Filed Apl. 26, 1893.

Employs two fixed electrodes and a movable body susceptible to electrification disposed in inductive proximity to the electrodes, its movement being counterbalanced by a spring.

Electric Meter, G. A. Schaeffer, Peoria, Ill., 530,351. Filed July 17, 1894.

Consists of a rotating element, a coil in parallel with the working circuit, and a second coil in inductive relation thereto; the coils acting to neutralize the effect of friction.

Miscellaneous:—

Apparatus for Extinguishing Fires, C. E. Manning, New York, 530,191. Filed Sept. 9, 1893.

Includes a rotary pump and a motor adapted to operate it upon the closing of any one of a series of switches placed at convenient points about the building.

Magneto Electric Machine, J. N. McLeod, Brooklyn, N. Y., 530,285. Filed Apl. 2, 1894.

The invention relates especially to electric blasting machines.

Electric Dental Engine, J. A. and B. A. Jeffrey, San Francisco, Cal., 530,344. Filed Apl. 5, 1894.

Apparatus for Casting Molten Material, G. A. Goodson, Minneapolis, Minn., 530,479. Filed Feb. 23, 1893.

Provides means for applying a current of electricity to the material to be cast while in transition from the furnace to the mold.

Railways and Appliances:—

Electric Railway System, D. Mason, New York, 530,192. Filed Feb. 16, 1894.

Employ a working conductor and a main conductor and means whereby the former may be both heated and energized from the latter.

Trolley Catcher, W. F. Kendt, Buffalo, N. Y., 530,276. Filed May 26, 1894.

Provides for automatically drawing down the trolley by means of a rotary spring drum.

Electric Tramway, H. Schwieger, Berlin, Germany, 530,286. Filed Dec. 22, 1891.

The invention consists in forming a channel between a pair of rails and locating within this channel a number of contacts in communication with insulated electric conductors.

Self-Lubricating Contact Bar for Electric Railways, F. W. N. E. Hayn, Berlin, Germany, 530,416. Filed May 12, 1894.

Electric Railway Supply System, J. J. Green, Boonton, N. J., 530,482. Filed Aug. 21, 1893.

A conduit system employing a sectional conductor and switches within the conduit acted upon by the contact shoe carried by the car.

Switches and Cut-Outs:—

Service End, Cut-Out, and Switch Box for Electric Lighting Circuits, J. Van Vleck, New York, 530,141. Filed May 28, 1891.

A switch connecting the ends of the street mains with the house conductors. (See THE ELECTRICAL ENGINEER, Nov. 28.)

Circuit Closer, H. V. Keelson, London, Eng., 530,184. Filed Sept. 17, 1894.

Electric Switch, I. W. Ullman, Birmingham, Ala., 530,293. Filed Sept. 28, 1894.

A double pole switch having a contact bolt operated by the oscillating movement of the lever.

Thermal Circuit Breaker, H. Klein, Janesville, Wis., 530,430. Filed May 19, 1894.

A spring contact held closed by a drop of fusible solder.

Electric Switch, J. M. Cronin, Cambridge, Mass., 530,472. Filed Sept. 22, 1894.

Telegraph:—

Telegraph Key, L. D. Bliss, Washington, D. C., 530,062. Filed Mch. 7, 1894.

Telephones and Apparatus:—

Telephone Transmitter, M. A. Morehouse, Waverton, N. Y., 530,115. Filed Mch. 28, 1894.

Employs an electrode bar rigidly connected with one side of the diaphragm, and pendant electrodes resting on the bar and angle.

Telephone Switch, A. Stromberg & A. Carlson, Chicago, Ill., 530,206. Filed Oct. 9, 1894.

Relates to certain construction of the receiver hook and mechanism for automatically cutting the telephone out of circuit when the receiver is hung up.

Telephone Transmitters, J. T. Williams, Brooklyn, N. Y., 530,815. Filed Aug. 3, 1894.

Consists of two independent bodies of conducting material incapable of mechanical vibration, in combination with a third body suspended between the first two and acted upon by a force to hold it in contact with both.

Telephone Exchange System, R. Callender, Brantford, Can., 530,824. Filed Aug. 13, 1894.

An automatic telephone exchange system in combination with a time mechanism for automatically disconnecting two lines at the central office.

Telephone Switch, R. Callender, Brantford, Can., 530,825. Filed Sept. 15, 1894.

Provides means by which the receiver cannot be held by the support when the circuit is closed through it.

Telephone Transmitter, J. & H. M. Goodman, Louisville, Ky., 530,412. Filed July 2, 1894.

Employs a vibratory magnet in contact with the diaphragm, a series of opposing magnets, and comminuted magnetic material interposed between them.

EXPERIMENTS ON THE DIRECT PRODUCTION OF ELECTRICITY FROM COAL AND COMBUSTIBLE GASES.

In a paper read recently before the *Deutsche Electrochemische Gesellschaft*, Dr. W. Borchers describes some interesting experiments he has been making on the direct production of electricity from coal and combustible gases.

His first experiments were made with carbonic oxide gas, but he also succeeded in producing an electric current by the combustion of hydrogen, hydro-carbon gases, and even from pulverized coal. His great invention, however, is the use of cuprous chloride as the electrolyte in his battery. It is well known that cuprous chloride is a good absorbent for both carbonic oxide and oxygen. It appears natural, therefore, to suppose that it will form a suitable electrolyte to promote chemical combination in a gas battery, with carbonic oxide and oxygen as its elements.

The first apparatus was made of any glass or stoneware vessel to hand, which could conveniently be divided into two compartments, communicating at the bottom. The vessel was partly filled with an ammoniacal or acid solution of cuprous chloride, air was supplied to one compartment and carbonic oxide to the other. When the carbon poles, with which the compartments were furnished, were connected, a weak electric current was obtained. By placing pieces of coke in the cells and thus increasing the surface of contact between the gas and the liquid, a considerable increase in the strength of the current was obtained. The results of this first experiment, if not exactly discouraging, were far from being up to expectation. Platinum poles would probably have given a better effect than carbon, but the use of this metal was forbidden by its price. It then occurred to the author that copper might be safely used as a pole in the carbonic oxide cell, the probability being that it would not be dissolved, since carbonic oxide precipitates copper from cuprous salts. This supposition was found by experiment to be correct, and it thus became practicable to make the vessel containing the electrolyte of copper, and to connect to it one of the terminals of the external circuit.

The preliminary apparatus by which these points were established is shown in Fig. 1. A glass vessel was divided into three compartments by two glass plates which did not reach quite to the bottom. In both the exterior compartments copper tubes were suspended for the introduction of the carbonic oxide gas. In the middle compartment, a carbon bell dipped, for the introduction

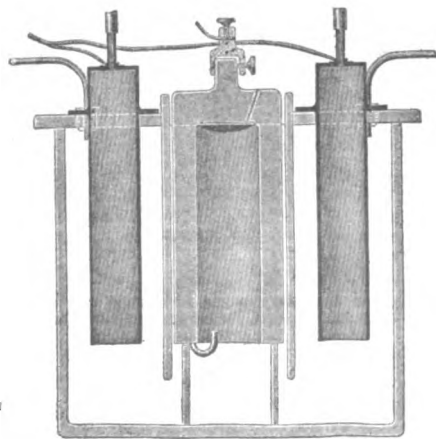
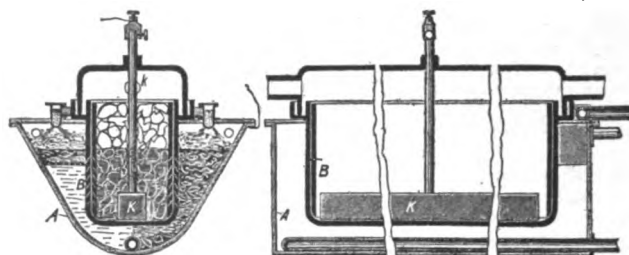


FIG. 1.

of air. A solution of cuprous chloride was used as the electrolyte. The copper tubes were weighed. The carbonic oxide cells were protected against the entrance of air by lids. The carbonic oxide, which was used in the first experiments, was afterwards, for convenience, replaced by coal gas, which contained at least 5

per cent. of the former. No decrease in the weight of the copper was at any time ascertained; on the contrary on one occasion a slight increase was observed.

Acid solutions of cuprous chloride gave better results than alkaline solutions. Table I. gives the results of measurements



FIGS. 2 AND 3.

made when carbonic oxide strongly contaminated with carbonic acid, and acid solution of cuprous chloride, and air, were used in the battery.

TABLE I.

External resistance in ohms.	E. M. F. in volts.	Current strength in amperes.
0.1	0.05	0.5
1	0.30	0.20
2	0.32	0.13
3	0.35	0.10
4	0.375	0.075
5	...	0.060
7	...	0.050
10	0.300	0.040
15	...	0.028
20	0.400	0.020
25	...	0.015
30	...	0.012
40	...	0.010
50	0.400	0.008

To facilitate the absorption of carbonic oxide by exposing a greater surface of contact the external cells were filled with copper clippings. By using at the same time a gas corresponding in composition to generator gas, a current of as much as 0.64 ampere was obtained on short circuit, while by gradually increasing the external resistance a maximum value for the E. M. F. of 0.56 volt was reached.

This result, to be sure, is not to be characterized as in every respect favorable, since the E. M. F. calculated from the chemical combination of carbonic oxide and oxygen alone is 1.47 volts. From the results of the experiments given above as compared with the maximum theoretical voltage, at least 27 per cent. of the energy of the fuel is converted into electricity. By the use of a gas among whose combustible constituents are, besides carbonic oxide, hydrogen and hydrocarbons, the effect appears to be still more favorable. According as the lowest or the highest values of these combustibles are taken, the electric energy produced is 38 per cent., or 26 per cent. of the energy of chemical combination. If, therefore, in a comparatively incomplete apparatus one-quarter to one-third of the chemical energy of the fuel can be converted into electricity, this success may well give encouragement to further efforts.

It is well-known that a solution of cuprous chloride also dissolves hydro-carbons. It may not therefore be necessary to convert the fuel into carbonic oxide. Powdered coal was tried in the above apparatus instead of carbonic oxide, and the strength of current and E. M. F. obtained were not far behind those obtained with gaseous fuel. A maximum E. M. F. of 0.3 volt, and a maximum current of 0.4 ampere was obtained.

The oxidation of carbon corresponds to a theoretical voltage of 2 volts; thus 0.3 volt corresponds to an efficiency of 15 per cent. Even with considerable motion in the liquid a falling off in the current soon takes place with coal dust, and this has never been observed with the use of carbonic oxide, or coal gas. The gradual pollution of the liquid with the use of coal would forbid its use even with a more favorable efficiency. The author considers that the use of the gas element is the only way by which success is likely to be attained.

The most recent design of the gaseous fuel element elaborated by the author after the trial of many forms is shown in Figs. 2 and 3. The external vessel, A, is of copper and contains the cuprous chloride electrolyte. The inner vessel, B, is of earthenware with double sides which are perforated, and contains the space for the cathode. The space between the double sides may

be filled with a porous material if necessary. The vessel, A, is furnished with a lid having two holes for the inlet and outlet of the gas, and an aperture in the centre through which a carbon rod, *k*, passes down to the carbon plate, K. The space above the carbon plate may be filled with broken coke to increase the surface of contact. For the same reason, the outer vessel is filled with clippings of copper. The cuprous chloride is supplied by channels running along the lid of the external vessel, A, and drawn off by a pipe at the bottom of the vessel. The gas and the electrolyte can thus be circulated through a series of cells in a large battery. Pipes are also fitted to circulate air in the upper part of the copper vessel. The author also describes a form of cell adapted for the combustion of powdered coal.

SOCIETY AND CLUB NOTES.

BROOKLYN ELECTRICAL SOCIETY.

The next meeting of this Society will take place on Dec. 18 at the Edison Assembly Rooms. Mr. James F. Hobart will deliver a lecture on "Practical Elementary Electricity."

LEGAL NOTES.

THOMSON ELECTRIC WELDING CO. vs. TWO RIVERS MFG. CO.

THE suit brought by the Thomson Electric Welding Company of Lynn, Mass., against the Two Rivers Manufacturing Company of Wisconsin, has been terminated by the entry of a decree sustaining the validity of the fundamental patents of Elihu Thomson on electric welding and apparatus therefor, and adjudging that the defendants have infringed the same. The Two Rivers Manufacturing Company has settled for the past and taken a license from the Thomson Electric Welding Company.

PERSONAL.

DR. S. S. WHEELER, electrical expert to the New York Board of Electrical Control, has resigned.

MR. J. W. GODFREY has severed his connection, we understand, with the New York Insulated Wire Co., of which he has been general manager, but will, it is said, remain actively engaged in the insulated wire field, with offices at 15 Cortlandt Street.

SIR JOHN PENDER, G. C. M. G., M. P., was entertained at dinner at the Hotel Metropole on Nov. 16, by the staff representatives of the Eastern Telegraph Company, the Eastern Extension, Australasia and China Telegraph Company, and the associated telegraph companies, on the occasion of their presentation to him of an illuminated address and testimonial commemorating the 25th anniversary of the establishment of submarine telegraphic communication with the Far East.

OBITUARY.

FREDERICK E. DEGENHARDT.

It is with much regret that we record the death of Mr. Frederick E. Degenhardt, western agent of the Standard Underground Cable Company, who died Friday, Dec. 7, at his home, 106 Seeley avenue, Chicago. Mr. Degenhardt was 38 years old and was widely known in electrical circles. His father, Charles Degenhardt, one of Chicago's oldest settlers, is a manufacturer of surgical instruments. After leaving school the son went to work for his father, but he soon turned his attention to the study of electricity and, for sixteen years, he gave all his effort to the construction of electrical devices. Many of his inventions were patented and are now in general use. He was connected for several years with the Western Electric Company, which he left to become the western agent of the Standard Underground Cable Company. He was of robust health until a few days before his death, when he took a slight cold, which developed into pneumonia. Mr. Degenhardt was married to Miss Emily Lockwood, of Tarrytown, N. Y., who, with two children, survives him.

MR. GEORGE H. ROE, president and manager of the San Francisco Edison Light and Power Co., died in this city on Monday last. The body will be sent home for interment. As a pioneer in the field, Mr. Roe was widely known and had many friends.

THE NEW YORK SUBWAY COMMISSION.

AT the last meeting of the Board of Electrical Control an application for a franchise was made by the Special Fire-Alarm Signal Co. President Pierce acknowledged that he had been doing business for the last twelve years without a franchise. The application was referred to Commissioner Kearney. The board passed a resolution to build a subway under the Harlem ship canal for the Metropolitan Telephone Co. The Madison Square Electric Light Co., the successor of the East River Thomson-Houston Electric Light Co. asked for and received a new franchise.

Trade Notes and Novelties AND MECHANICAL DEPARTMENT.

THE BELKNAP MOTOR CO.

THE BELKNAP MOTOR CO. of Portland, Maine, report busy times. They are just completing a plant for the U. S. Marine Hospital using an Ideal engine and boiler together with two B. C. standard dynamos. They are also completing the lighting plant for the new steamer "Bay State" for the Boston & Portland Line which requires two direct coupled dynamos and engines multipolar type. The Ideal engines are used and coupled direct with the Belknap multipolar machine. A finer plant could not be devised, either of the machines being large enough to light the boat alone. The following orders have recently been booked: The Shaw & Morse Lumber Co. of Bangor, Me., a 150 light plant; the Perkins & Danforth Spoolwood Co. of Norcross, Me., a light plant complete; John MacGregor of S. Lincoln, 150 light plant, 2nd order; the new Deering Toothpick Co. a light plant; and many others.

P. & B. SPECIALTIES.

THE Metropolitan Electric Co., 186 Fifth Ave., Chicago, western agents for the P. & B. specialties of the Standard Paint Co., have sent in to the home office some very large orders for P. & B. compound, motor cloth and tape, especially the last named article. They have within the last month alone, ordered several thousand pounds of P. & B. insulating tape, and although the Metropolitan Electric Co. took up the sale of the P. & B. goods during the recent hard times, and have been handling them but little over a year, they in that time, have doubled the company's electrical business in the West. The Standard Paint Company say that if they could find a few more representatives like them they fear they could scarcely make enough goods to supply the demand.

NEW ENGLAND NOTES.

THE WHITNEY ELECTRICAL INSTRUMENT CO., of Penacook, N. H., have appointed Mr. H. S. Sands, of Wheeling, West Va., agent for their instruments in the state of West Virginia and the Western part of Pennsylvania. Mr. Sands who is an energetic contractor and engineer, will carry a line of the Whitney instruments sufficient to meet the wants of the trade in that locality, and will without doubt meet with much success.

THE W. S. HILL ELECTRIC CO. of Boston, have appointed Mr. J. A. Machado, of 203 Broadway, New York, as their representative for New York and vicinity. Mr. Machado is at present the selling agent of the Waddell-Entz Co., and is well known to the trade. The W. S. Hill Co. still continue to receive large orders for their switches, and are now behind hand on delivery. They have turned out a large number of handsome switchboards of late, and appear to have the call on that class of work in this vicinity.

CAPTAIN A. DEKHOTINSKY, has severed his connection with the Van Choate Electric Co., of Boston, a piece of news which will undoubtedly be pleasing to his many friends and admirers in the scientific world. It is a matter of satisfaction that he has at last broken away from a company which has had an existence for several years, but which has never as yet to our knowledge been able to put out any apparatus. No doubt the Van Choate Co. were in hopes that Captain DeKhotinsky, than whom no better lamp manufacturer lives, would develop a lamp for them, but we hope to see his efforts put forth in a better field, and with some company who will not claim the earth, and malign all other existing companies who venture to manufacture apparatus on sound scientific principles.

WESTERN NOTES.

THE NUTTING ELECTRIC COMPANY, has been organized at Chicago; capital stock, \$50,000; incorporators, James W. Hedenberg, Carl K. MacFadden and Frank A. Smith.

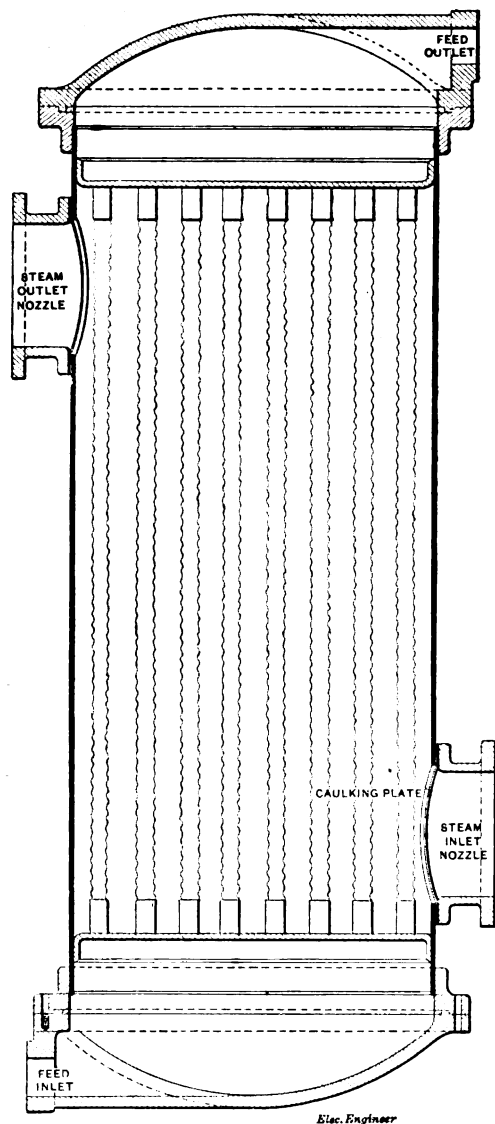
THE METROPOLITAN ELECTRIC COMPANY have taken the general western agency for the Large and Twining station and line switches and are getting in a large stock of all sizes. The company are sending out a little booklet describing the Ideal lightning arrester, for which they are the general agents.

THE ELECTRIC APPLIANCE COMPANY are making a special drive at present on "C. E. M." jack-knife and motor switches offering them at greatly reduced prices and displaying a very extensive stock. The C. E. M. switch is one of the first jack-knife switches on the market having the spring catch to hold the jaw open or closed and give it a quick and positive action. This switch is well-known and has always been popular.

NEW WAINWRIGHT WATER TUBE HEATER.

ECONOMY in steam consumption requires the utmost utilization of the heat energy contained in the steam and there is no more valuable auxiliary for that purpose than the feed water heater. The new Wainwright heater, manufactured by the Taunton Locomotive Mfg. Co., of Taunton, Mass., is of the water tube type; that is to say, the water enters at the bottom through the dished head, and passes up through the tubes and out at the top, steam entering through large nozzles into the shell.

This heater is intended for the very best and heaviest work. The tube plates are of boiler plate steel $\frac{5}{8}$ " thick and the tubes, which are of the best Lake copper, are set into the holes in this tube plate, in the following manner. Each tube is plain for about 3' from the end; this allows the surface to be rolled into the hole



NEW WAINWRIGHT WATER TUBE HEATER.

in the tube plate by means of a Dudgeon expander, or any other expanding tool. When a perfect joint is secured in this way, a brass thimble is driven as hard as it will go into the tube and the end of the tube is carefully beaded over. There is nothing new in this, of course, as it is in the line of the best boiler practice, and has been for many years, but it makes the best possible job that can be done. This rigid fastening at each end is made possible by the use of the corrugated tubes, which are sufficiently flexible to take care of the expansion and contraction caused by the changes in temperature, with perfect ease. This is no longer a question of theory, but has been demonstrated by the company's practice for many years.

Two heaters of this particular type have recently been constructed; one for the St. Louis Electric Light Company at St. Louis, and one for the electric light plant, at Nashville, Tenn. There are but two joints in the heater, one at each end, and these are made in such a way as to make it very easy to break the joint and set the cover on again. When bad water is used, the cover may be removed and the tubes cleaned out by any flue brush as

easily as any boiler. The dirt will fall into the bottom of the chamber and can be blown out through a suitable mud blow-off. Heaters of this type may be used either horizontally or vertically. When used horizontally, with both exhaust nozzles on one side, it is sometimes customary to place a deflecting plate on the upper side of the shell to make sure that the steam does not take a short cut from one nozzle to the other.

Among orders recently placed by the Taunton Company, for Wainwright heaters, may be mentioned the following, as covering some of the larger sizes: One 2500 gallon combined storage tank and heater to the Mass. General Hospital, Boston, Mass.; one 300 H. P. water tube heater to Russell & Co., of Massillon, O.; one 200 H. P. steam tube heater to Monterey, Mexico; two 150 H. P. water tube heaters to T. T. Burchfield, of Philadelphia, Pa.; one 300 H. P. water tube heater to Woonsocket Rubber Company; two 700 H. P. steam tubes and one 500 H. P. water tube for Pierce & Miller's Baltimore contract; one 1500 H. P. for St. Louis Electric Light Co.; one 1200 H. P. for Nashville Electric Co.; an order of thirty expansion joints to the McGuiness-Smith Co., of Pittsburgh, Pa., together with other small orders for thirty-four joints of various sizes, making sixty-four (64) of these joints, within the past two months.

SALES OF McEWEN ENGINES.

AMONG the recent engine sales made by the J. H. McEwen Manufacturing Co., Ridgway, Pa., are the following:—Two 150 H. P. simple, direct connected to General Electric generators, Continental Hotel, Philadelphia; one 350 H. P. simple, direct connected to Walker Manufacturing Company generator, Akron Street Railway Co., Akron, Ohio; two 60 H. P. tandem compounds, direct connected to C. & C. generators, to Dundee Rapid Transit Co., Elgin, Ill.; one 50 H. P. simple, to Parmalee Eccleston Lumber Co., Jacksonville, N. C.; two 130 H. P. tandem compounds to R. Duns-muir & Co., San Francisco, California; two 800 H. P. to Granite Steel Co., East St. Louis, Mo.; one 150 H. P. simple engine to Huntingdon Electric Light Co., Huntingdon, Pa.; one 175 H. P. to J. H. Somers Fuel Co., Belle Vernon, Pa.; one 280 H. P. tandem compound to Scranton Electric Construction Company, Scranton, Pa.; one 125 H. P. to New York & Penna. Co., Johnsonburg, Pa.; one 85 H. P. simple engine to Independent Electric Co., Atchison, Kan.; one 100 H. P. to New York & Scranton Coal Co., Peckville, Pa.; one 125 H. P. simple, to Young & Harrington Coal Co., Shippler, Pa.; one 175 H. P. simple, to Walter & Ferris Coal Co., Salem, Ohio; and one 125 H. P. simple, to Scranton Electric Construction Co., Scranton, Pa.

RAILWAY SUPPLIES WANTED.

The Electro-Magnetic Traction Co., of Washington, D. C., a description of whose experimental road appeared in these columns on November 28, write us that they will require in the course of a few weeks several miles of iron conduit pipe, insulated lead sheathed cable, 200 tons of castings, 5,000 rubber gaskets and bushings, 10,000 bolts and nuts, 1,000 slate bases for switches, and other sundry supplies. Drawings and specifications can be obtained from the Superintendent and Engineer, Mr. William Chapman, 35 Corcoran Building, Washington, D. C.

REORGANIZATION OF THE THOMSON-HOUSTON ELECTRIC CO. OF NEW YORK.

This company, against which the Holland Trust Company last August secured a judgment for \$600,000, has filed a certificate with the Secretary of State, reorganizing as the Madison Square Electric Light Company, with an exclusive common stock of \$1,000. The directors are George W. Maslin, Arthur Freeland, Richard Lankford, William Townsend, Edmund Merrill, I. S. Lewis and Patrick Nolan.

ENGINE PROPOSALS WANTED.

Bernard R. Green, Superintendent and Engineer of the construction of the Library of Congress, Washington, D. C., 141 East Capitol Street, invites proposals until December 30, 1894, for furnishing, delivering and putting in place complete three 16'x15' high-speed, horizontal, centre-crank, single valve automatic steam engines, for dynamos for the new library building.

MR. FRANK X. CICOTT, Manager Railway Department of the Pettingell, Andrews Co., Boston, sailed on the S. S. "Lucania," December 1, for Europe in connection with that company's girder rail business with Messrs. Dick, Kerr & Co., Ltd., London.

Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE Electrical Engineer.

Vol. XVIII.

DECEMBER 19, 1894.

No. 346.

THE LOUISVILLE, KY., ELECTRIC LIGHT CO.'S STATION EXTENSION.

THE new extension to the station of the Louisville Electric Light Co.'s plant which has been added within the last few months, faces on Magazine street, and abuts upon the north end of the old extension. The addition is constructed of the same materials as the other buildings, with which its appearance harmonizes well. The new building measures

The dynamos have been designed and built especially for the Louisville station by the Westinghouse Electric & Mfg. Company, and hence may be fairly said to exhibit the latest development and the most recent improvements in dynamo design. The engines were built by the E. P. Allis Company, of Milwaukee, Wis., who constructed them expressly to meet the conditions of this installation. The result of this company's excellent design and workmanship is attested by the smooth running of the

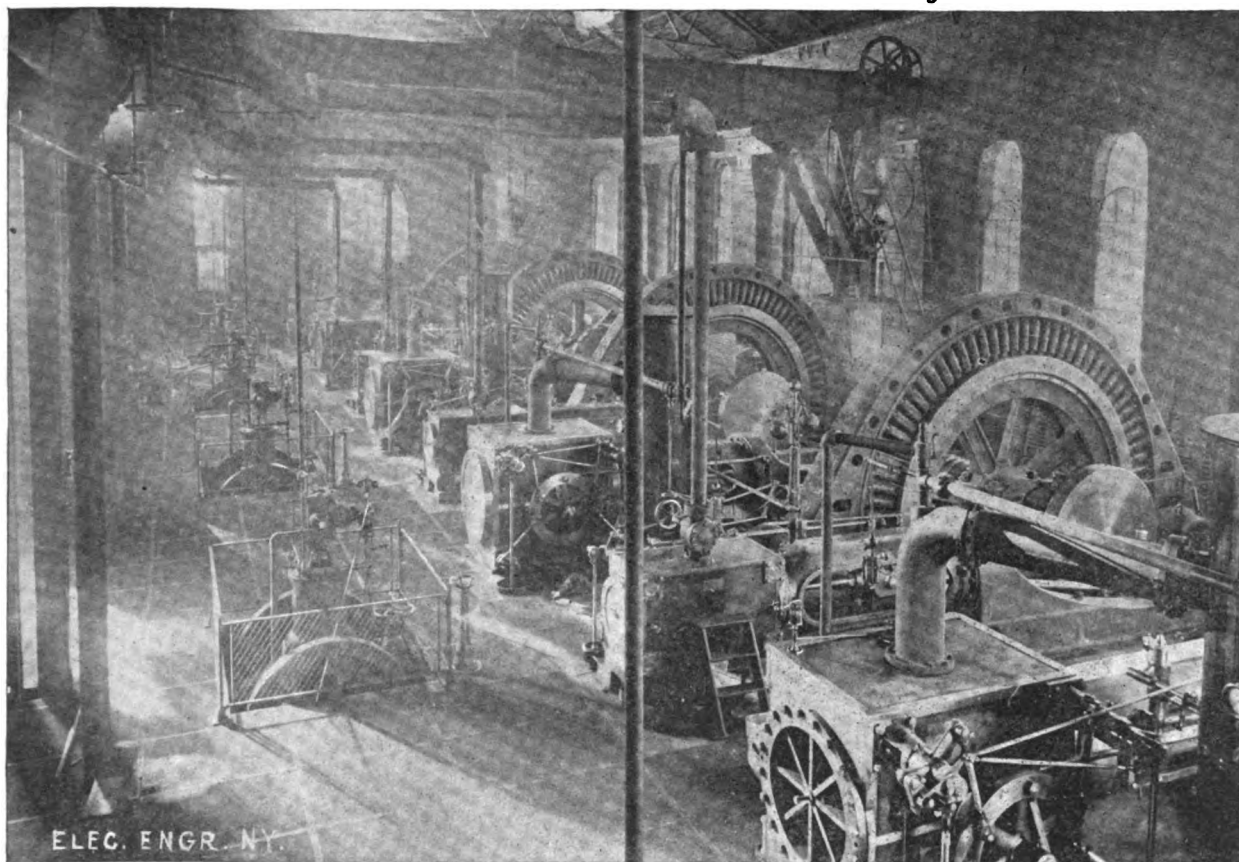


FIG. 1.—ENGINE AND DYNAMO ROOM, LOUISVILLE ELECTRIC LIGHT CO.

156 ft. in length, and 54 ft. in width and the whole interior is one spacious room, open to the ridge pole of the trussed slate roof, which is 62 ft. above the floor of the station. For handling the large and heavy apparatus here in use, there has been installed a 10-ton Phoenix traveling crane, which permits the convenient and ready erecting or dismantling of apparatus here installed.

The equipment of the new extension consists of five direct connected units, and condensers, as follows:—One 500 H. P. 500 volt multipolar direct current generator, four 500 K. W. 2,500 volt (7,200 alternations per minute) alternators, five Allis-Corliss cross compound engines, and five Reynolds condensers.

engines, and the satisfactory operation of the complete units.

The engraving Fig. 1 shows a general view of the interior of the station, taken from the point just back of the engine which drives the direct current generator. The engraving Fig. 2 very clearly indicates the general appearance of the alternators, and shows the field drawn back to allow access to the armature and interior parts.

As the four alternators, with their engines, are exactly alike, the description of a single unit will suffice for all. The engines are each astride of their dynamos; that is, the low pressure cylinder guides and crank shaft are on the collector ring or commutator side of the generator, and the

high pressure cylinder, etc., on the other side. This arrangement eases the bearings, avoids undue flexural strains on the shaft, and tends to smooth and easy operation. The type of engine used is too well known to need any further description other than that it is of the standard Corliss type, embracing all of Mr. Reynolds' improvements. The engines and dynamos are mounted on brick, laid in sharp sand foundations with stone copings.

Steam is supplied to the high pressure cylinders at a boiler pressure of 160 pounds per square inch, through 8-inch steam pipes which are connected to a heavy 20-inch lap welded main running the length of the building some 20 feet above the floor. For the common over-flow, a 16-inch cast iron hub pipe is laid beneath the cellar floor.

The cylinders of the engines connected to the alternators are of 18 and 36 inches diameter, respectively, and have a piston travel of 42 inches. The engine connected to the generator is somewhat smaller, having cylinders of 16 and 32 inches and a stroke of 38 inches. Under full load the engines run at 90 revolutions per minute.

In accordance with the Westinghouse practice, the field of the alternator consists of a circular cast iron yoke, having inwardly projecting laminated pole pieces. These are of soft sheet steel punchings, properly insulated, built up between heavy end plates, and all riveted together. The pole pieces thus constructed are then cast solid in the yoke, thereby affording protection from Foucault currents, securing perfect magnetic circuits, and allowing high density in the fields. The exciting coils are wound on rigid metal bobbins, which, after being completed,

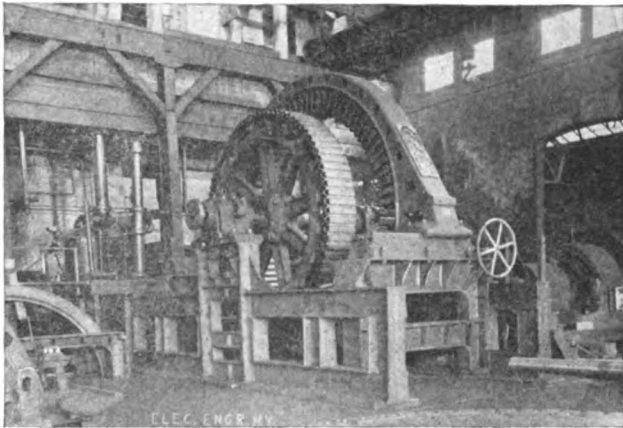


FIG. 2.—WESTINGHOUSE ALTERNATOR, LOUISVILLE ELECTRIC LIGHT CO.

are slipped over the pole pieces and bolted into position. The coils are all connected in series and supplied with current at 250 volts potential from the Westinghouse multipolar exciters in the old station. These alternators are all separately excited and hand regulated, as practical experience seems to indicate that the best results can be secured in machines of such size from other than self regulation. The armature is of the same general type as that used for the mammoth alternators which made such a creditable record in the Westinghouse lighting plant at the World's Fair in Chicago last year.

One of the most novel, and at the same time valuable features in the design of the alternators, is the arrangement for separating field and armature for purposes of inspection and repair. The machine has no bed plate, in the usual sense of that term, but is hung partly in a pit, so that the armature shaft is only a little above the floor level, and at a height convenient for direct connection to the crank shaft of the engine.

The field yoke, complete, is supported just below its middle points upon two slides, which run parallel to the armature shaft. This is very clearly shown in the engraving of the machine, which shows the field drawn back. By

means of tension screws the whole field can be moved along the slides until completely withdrawn from the armature, thereby permitting ready access to any part of the

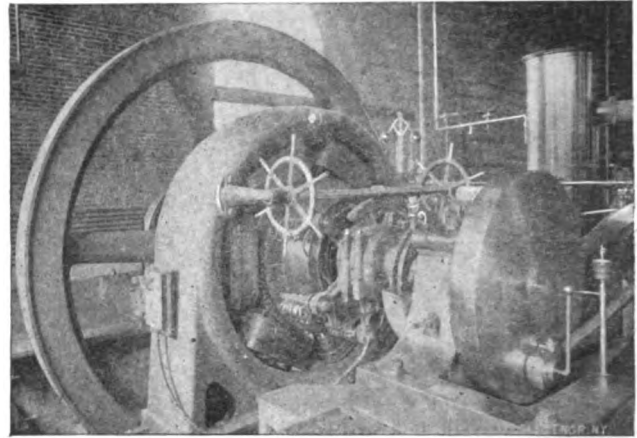


FIG. 3.—500 H. P. WESTINGHOUSE DIRECT CURRENT GENERATOR, LOUISVILLE ELECTRIC LIGHT CO.

machine, without in any way disturbing the electrical conditions, or loosening the engine connections.

The large 500 h. p. continuous current generator, direct connected to the smaller Allis engine, is shown in Fig. 3.

As will be noticed, the machine has six massive pole pieces, projecting from a heavy cast iron yoke, which latter is supported on a base plate somewhat depressed below the floor level, in order to accommodate the engine. A heavy fly-wheel is mounted directly on the armature shaft, between the wheel and further crank. The field measures 10 feet in height, and, as will be noted, is divided vertically slid apart by means of ratchets and levers, without disturbing the armature or engine. The pole pieces are built up of sheet punchings, cast solid into the yoke, exactly like those of the alternator described above.

The field coils are wound on large bobbins. The shunt and series coils are wound side by side, but they are entirely distinct from one another, and are so arranged that they can be removed or repaired without disturbing the other set.

The armature is of the standard direct current generator type. The core consists of a laminated ring supported by a cast iron hub or driver, which is under great pressure on to the commutator, built of the copper segments, and insulated with mica, measures 45½ inches in diameter, and of the fine grade of insulation used, and the method of con-

necting the field coils to the armature shaft. The commutator, built of the copper segments, and insulated with mica, measures 45½ inches in diameter, and of the fine grade of insulation used, and the method of con-

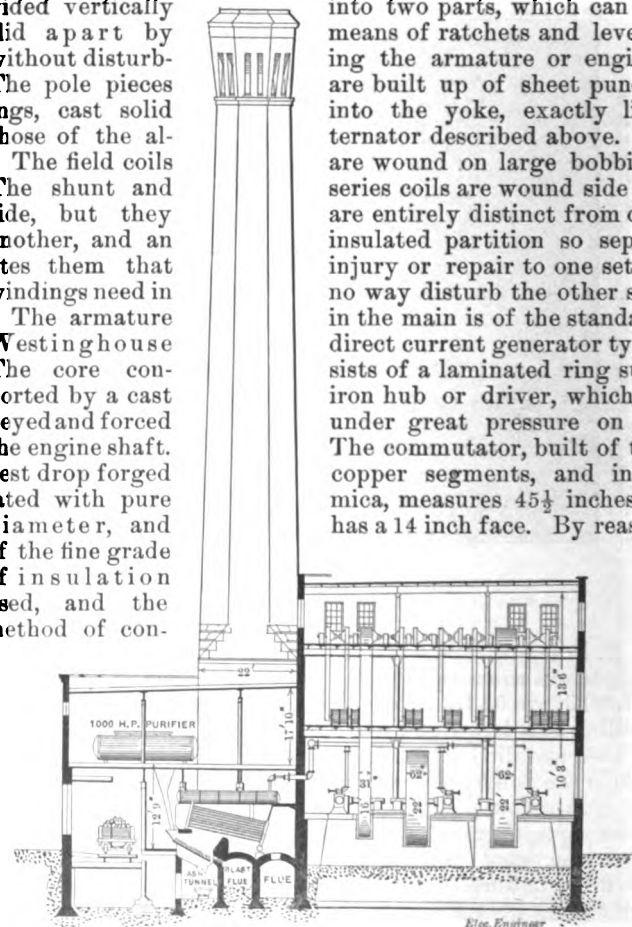


FIG. 4.—SECTION OF OLD STATION, LOUISVILLE ELECTRIC LIGHT CO.

struction in this generator, it will stand particularly high voltage. Before being shipped it was tested at a pressure of 2500 volts on both the field or armature. In machines of such large type, of course it is possible to secure very high efficiencies, and the Westinghouse Company have guaranteed that this machine shall have at least 90 per cent. efficiency.

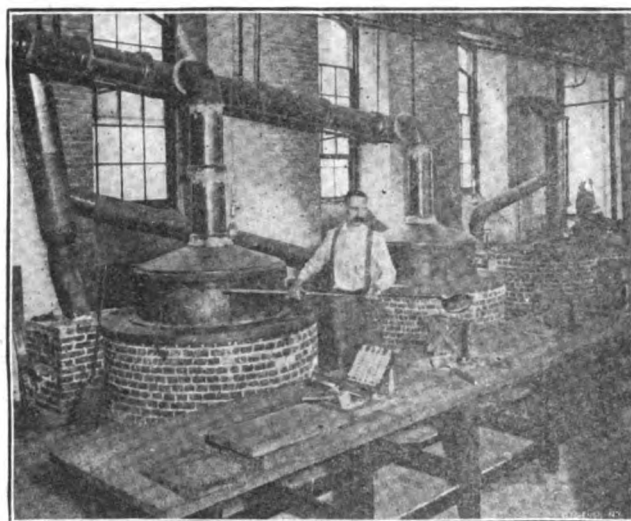
The engraving Fig. 4 shows the old station and brings out in marked contrast the difference in construction between it and the new extension.

Taken as a whole, the station is most interesting and instructive to any one operating either direct or alternating current machines. The good order in which everything about the station is kept, and the smooth running and successful operation of the machines, attest the capabilities of the engineer in charge, Mr. G. W. Hubley, to whom we are indebted for much of the information herein contained.

THE MANUFACTURE OF CHLORIDE ACCUMULATORS.

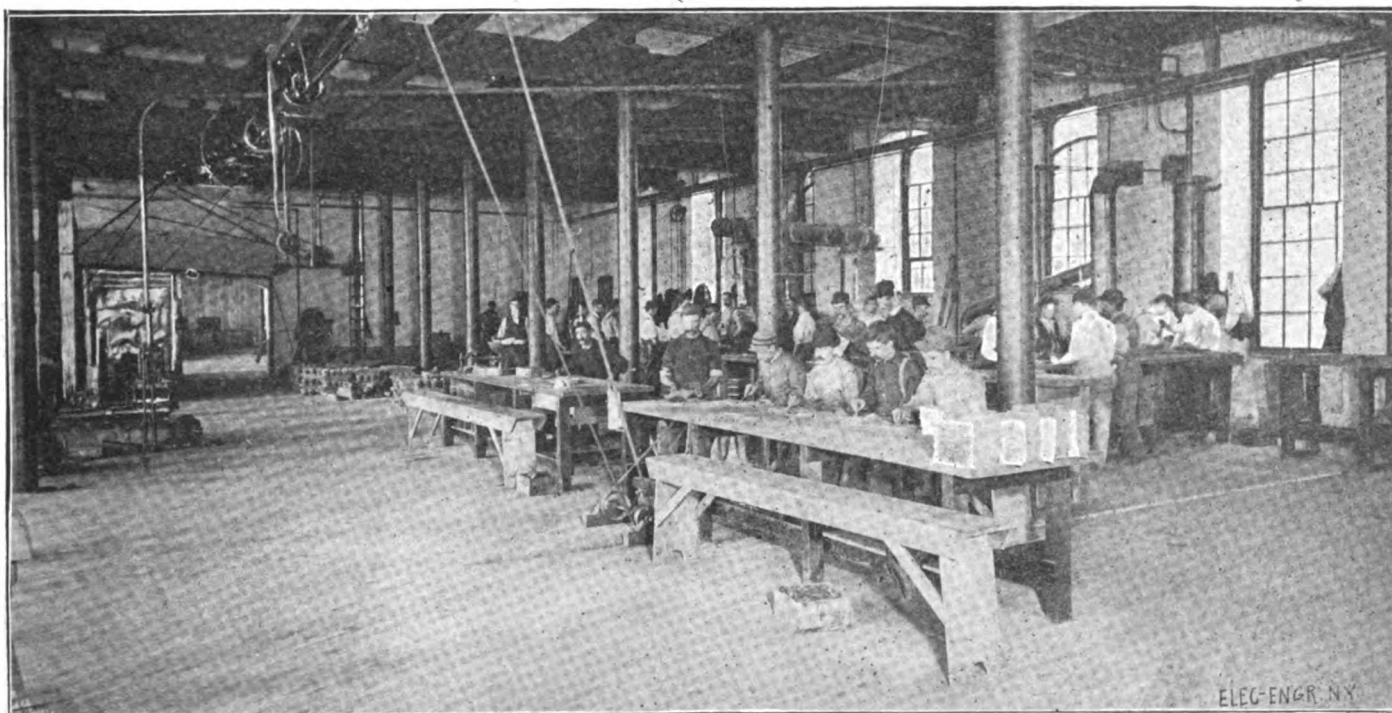
THE generation and distribution of electricity at the present time presents aspects quite different from those of ten years ago. At that period the novelty of the electric light had not yet worn off, and in the praiseworthy endeavor to obtain recognition for the new illuminant, and to push it forward, much was done that later practice has shown to be open to criticism. On the other hand it must also be borne in mind that aside from methods, pure and simple, the electrical engineer did not possess at that time the materials and apparatus which are now available and which can now be combined in a manner best suited to each individual case. In central station practice, especially, it was early found that one of the greatest difficulties to contend with was the variable character of the load, and the question of the size of units best adapted to each case

An interesting analysis might be made of the causes which have until recently made the storage battery a by-word of reproach in America, but the task would not be



CASTING THE CHLORIDE PASTILLES.

congenial and would, besides, lead us too far. Suffice it to say that indications now point strongly to the approaching ascendancy of the storage battery as a factor in current distribution in the United States and we anticipate especially good results to arise from the combination of storage battery interests just consummated. The leading spirit in bringing about this happy result was the Electric



CASTING AND PLATE FINISHING DEPARTMENT, ELECTRIC STORAGE BATTERY CO.

was a favorite topic of discussion among central station managers. The question is equally important at the present time, but it has assumed a phase quite different from that of only five years ago. This changed aspect has been brought about by the practical and intelligent application of the storage battery.

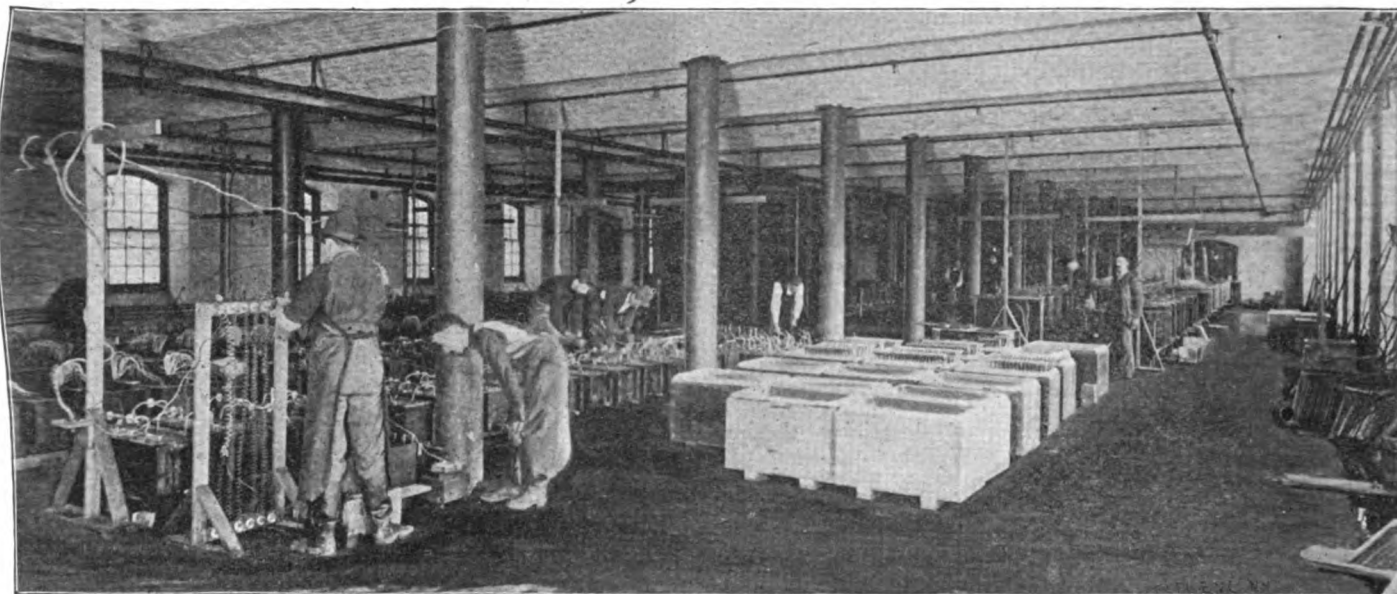
Storage Battery Co., of Philadelphia, whose aggressive policy, based on confidence in the inherent value of the storage battery, has perhaps more than any other factor contributed towards placing the storage battery in its present recognized position in America.

It is now nearly five years since this company began

operations in its works, then situated at Gloucester, N. J., where it developed processes which have culminated in methods calculated to give that uniformity in storage bat-

doubt, the largest and best appointed storage battery manufactory in the country.

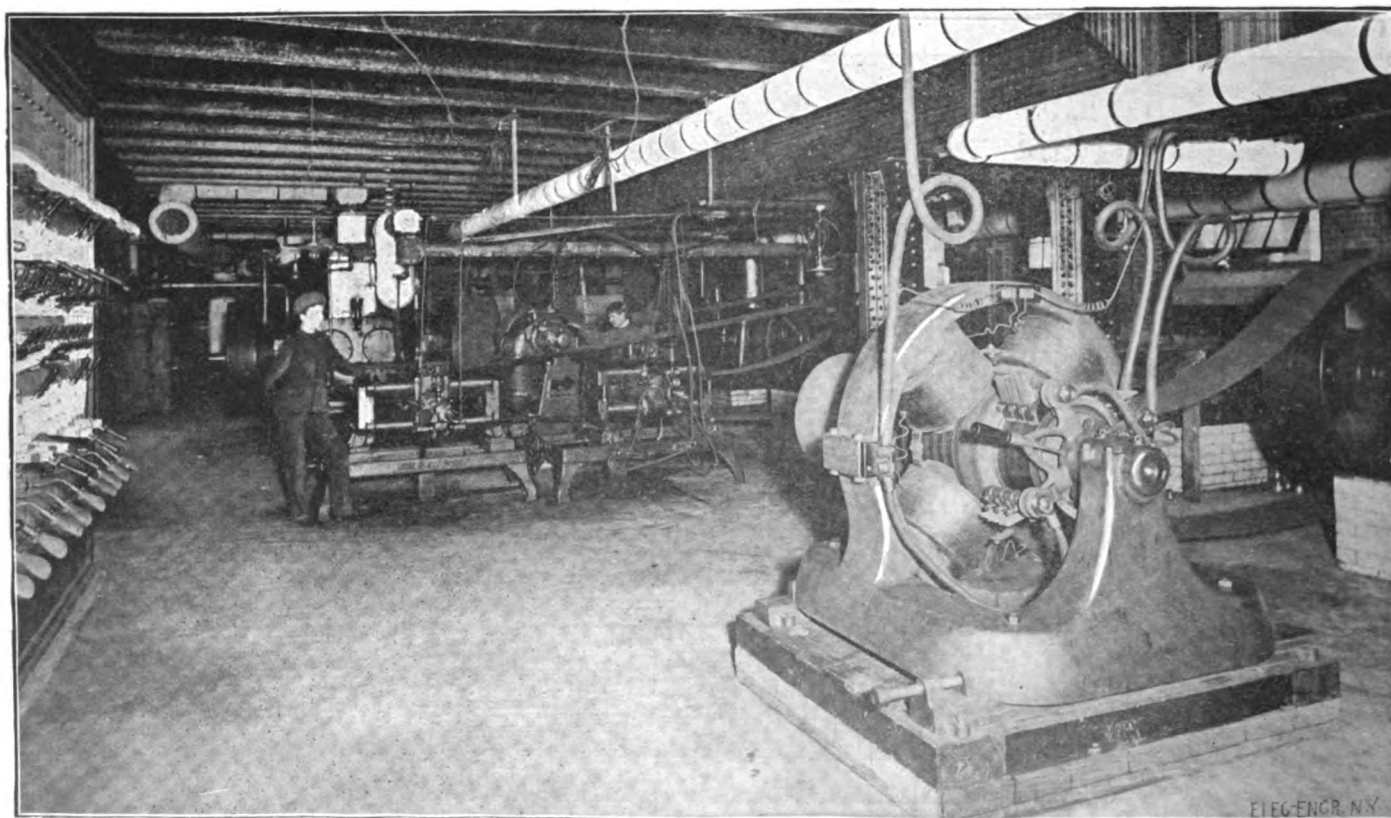
Desirous of obtaining the best factory facilities which



THE FORMING ROOM, ELECTRIC STORAGE BATTERY CO.

tery plates without which success in their practical use can not be hoped for. The recent removal of the Company's works to Philadelphia, and the new manufacturing equip-

modern engineering skill has now made available the Electric Storage Battery Co., have taken up their quarters in the new Warden Power Building in Philadelphia. This



DYNAMO ROOM, ELECTRIC STORAGE BATTERY CO., PHILADELPHIA.

ment, merits, we think, more than passing notice and we believe our readers will be as much interested as we were ourselves in a saunter through what is, without a

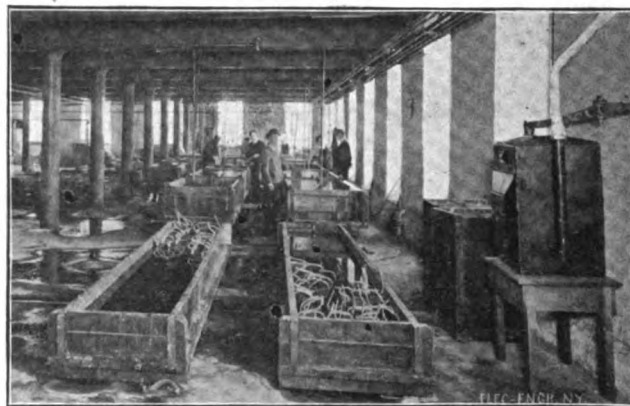
enormous structure, seven stories in height and built in the shape of an U facing on 18th Street at Allegheny Ave., occupies an entire square and constitutes the most

prominent landmark in that section of the city. The building was designed by Mr. Walter Geisinger, the well-known mill engineer and a description of its numerous features of excellence would prove of vast interest, but must, of necessity, be here foregone. We shall content ourselves with the remark that it has been pronounced by competent judges to be the best appointed power building in the country.

Entering the main door we turn to the left and find ourselves in the offices of the Electric Storage Battery Co., where we are taken in hand by Mr. Herbert Lloyd, the general manager of the Company who accompanies us on our tour of inspection.

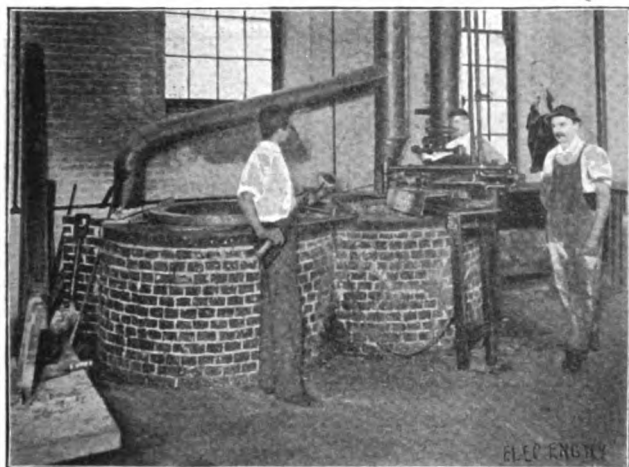
But before we start out to see how the battery is made, a brief history of the steps which led up to its present stage of development is in order, and will aid in a better

The first step in the production of the chloride consists in reducing commercial lead to a fine powder which is accomplished by directing a blast of compressed air against



THE REDUCING ROOM.

an orifice from which issues a fine stream of molten lead. The result is a spray of lead which cools and falls as a powder. The lead finely divided in this ingenious way is next dissolved in nitric acid and then precipitated as chloride of lead by the addition of hydrochloric acid. The white chloride of lead after being thoroughly washed and dried forms the basis of the material which subsequently becomes active in the battery plate and as such its production is carried on with the greatest care and supervision to prevent the introduction of impurities.

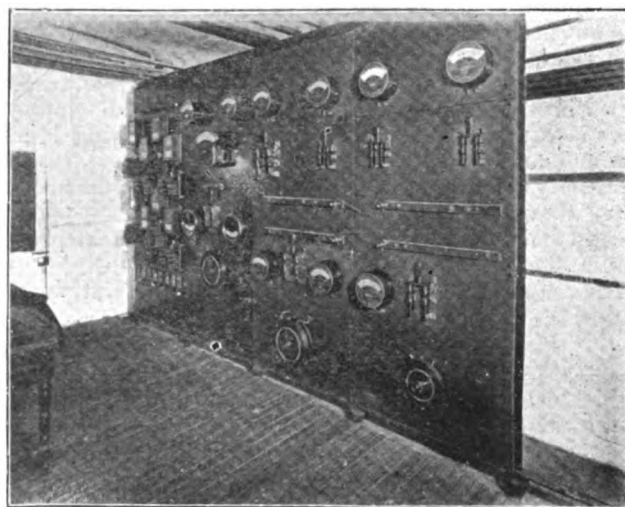


CASTING THE LEAD FRAMES UNDER PRESSURE.

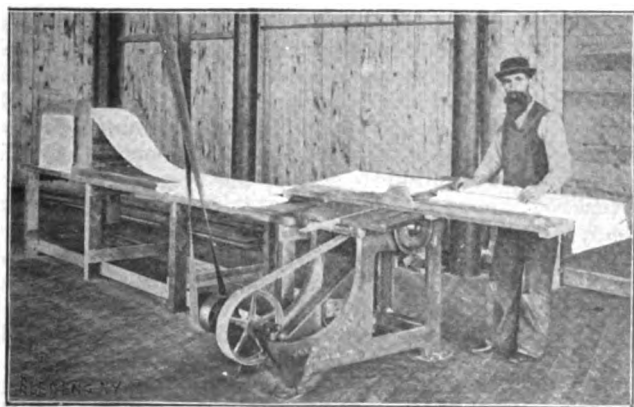
understanding of the actual processes which we will pass in review.

As we remarked at the outset, homogeneity in the active material is a *sine qua non* of a successful storage battery plate, and while spongy lead may be reduced from a number of different lead salts, there are but comparatively few that are at all suitable for storage battery purposes, and among these the chloride of lead has been found by the Company after a long series of experiments, to be the best adapted.

In order to be certain of the purity of its working mater-



THE CHARGING SWITCHBOARD.

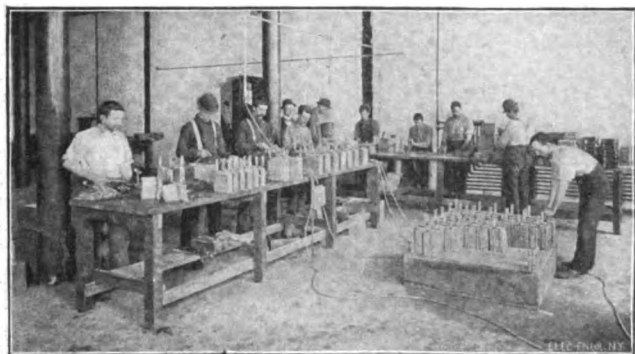


CUTTING UP THE ASBESTOS CLOTH.

ials the Company itself from the very start undertook the manufacture of the chloride of lead and developed special processes to that end.

Emerging from the office we enter the capacious casting room illustrated in the engraving on page 491, where we find two large furnaces, in which the chloride of lead, mixed with a certain proportion of chloride of zinc, is brought to a molten state. These crucibles are heated by a furnace situated on the floor below, in which crude petroleum is burnt by means of a steam spray blast. The pastilles which subsequently form the active material of the battery are cast in a mould, the metal being ladled out by the workman, as shown in engraving on page 491. The same engraving shows one of the moulds open, exhibiting the manner in which the pastilles appear after cooling. These pastilles are not poured solid, but the mould is so arranged as to leave them with a hole in the centre, by which they are subsequently located and held in position in the casting frame of the lead mould.

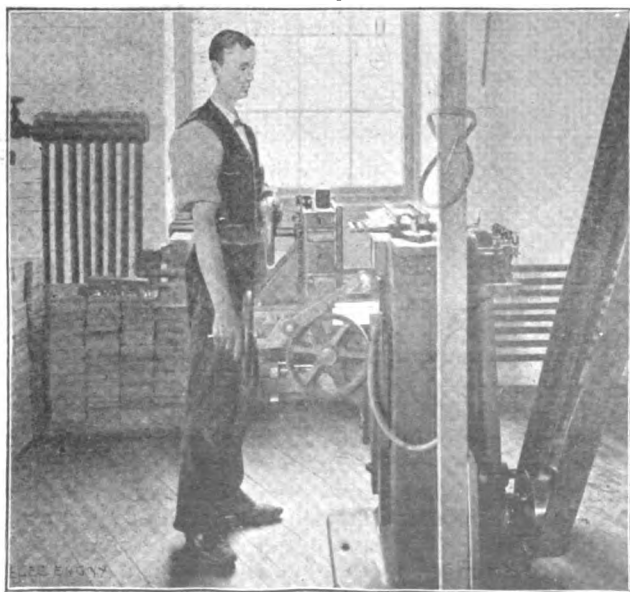
Directly to the right of the chloride furnaces are the lead casting furnaces, the two being placed close together so as to make necessary the least possible handling and



BURNING ON THE CONNECTING STRIPS.

transportation of material. To those who have witnessed the old method of pouring lead storage battery grids by hand, the method here adopted will prove a source of much interest. Instead of the old, slow and somewhat uncertain method, the arrangement adopted is the forcing of the lead into the grid under pressure of 75 to 180 pounds per square inch, depending upon the size of the plate, filling the mould completely and leaving no chance for blow holes. The chloride pastilles are placed in the mould, being held in position by pins projecting through the holes provided at their centres. The mould is then introduced into the lead casting press, a turn of the handle opens the valve leading to the lead furnace, and a turn of a second valve admits the air pressure, which forces the lead into the mould. The entire operation requires less time in its performance than that occupied in describing it here, and the result is a grid firmly grasping the pastilles. The lead employed has a slight addition of antimony to aid in giving it stiffness and non-corroding properties. The two furnaces have a capacity for casting ten tons of battery plates per day. After they leave the press the plates are finished and scraped smooth, and are now ready for the next process, that is, the reduction of the chloride.

The reducing process is carried on on the first floor of



PERFORATING THE WOODEN SEPARATORS.

the building and the room in which it is conducted is shown on page 493. The plates as they come from the room above are stacked by alternating each lead plate with a slab of zinc, all immersed in tanks filled with dilute chloride of zinc. The plates so assembled, constitute, in fact, a primary battery, and, by short-circuiting them, the chloride of lead is reduced. The chlorine leaving the pastilles forms chloride of zinc, and the pastille is finally reduced to crystalline lead. After the reduction is complete it only remains to wash the plates thoroughly in running water, in order to remove the last traces of zinc chloride. The reducing process occupies about 48 hours.

The reduced plates are now assembled and have the lead connecting lug burnt on them by means of the hydrogen flame. The plates that are intended for the negatives of the cell require no further treatment, as they contain the pure, spongy lead, but those designed to act as anodes, or positives, must, of course, undergo treatment to convert



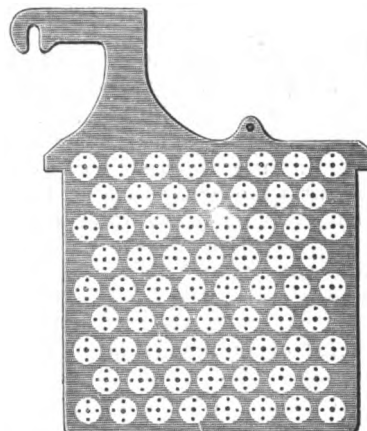
REAR COURT, ELECTRIC STORAGE BATTERY CO.'S FACTORY.

the spongy lead into the peroxide. The forming process is carried on in the room illustrated on page 492, which, like all the other rooms, is particularly adapted to this work. The floor of the forming room is of asphalt, the ceiling of hollow tiles, supported by steel columns, covered with acid-proof paint. The plates, immersed in tanks filled with dilute sulphuric acid of the proper strength, receive a continuous charge of two weeks' duration in one direction, which thoroughly converts the spongy lead into peroxide. The current for forming the plates is furnished by one 500-ampere and two 200-ampere machines of 125 volts each, illustrated in the engraving, page 492, which shows the dynamo room situated under the dome of the central court, between the wings of the main building. The switchboard from which the charging current is distributed is illustrated on page 493, and is fitted with the most improved devices and apparatus for obtaining accurate indications, Weston instruments being employed. Among the latter we noticed a Weston ammeter in which the zero mark occupies the centre of the scale which reads both ways, a design which was suggested to Mr. Weston by Mr. Herbert Lloyd, general manager of the company.

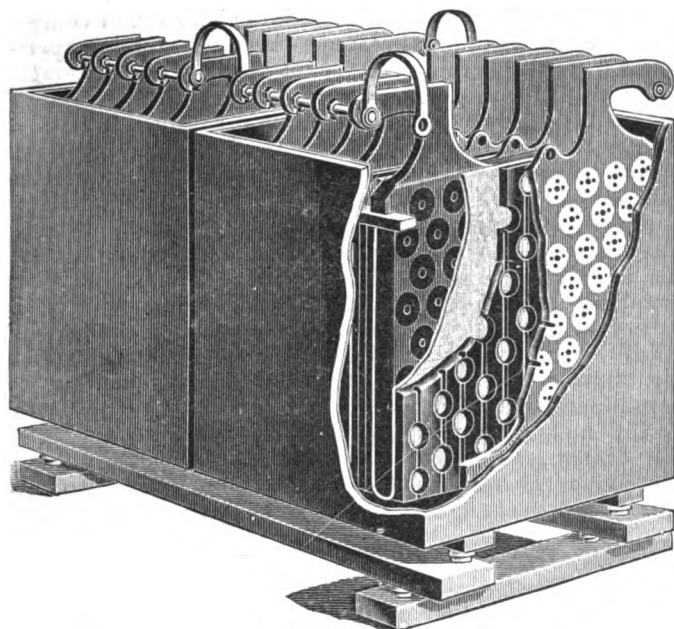
With the peroxide completely formed the positives and negatives are now ready to be assembled. In order to ensure the integrity of each individual plate, special means are provided in the Chloride cell for maintaining the plates of opposite polarity separate from one another, and for this purpose each positive plate is first covered on both sides by a sheet of asbestos cloth, as shown in the engraving of the cell on this page. In addition to this, however, a further stiffening is obtained by the introduction of a partition of cherry wood, which is perforated by numerous holes, the perforations being connected by grooves so as to admit of the free circulation of the electrolyte. Our engraving on page 493 shows a workman cutting up the asbestos cloth by means of a circular knife, and that on page 494, illustrates the machine which bores the holes in the wooden partitions, being so arranged as to perforate 12 boards with 16 holes each simultaneously. For the purpose of grooving the separators they are passed under a circular saw, consisting of a gang of eight saws. Adjoining the rooms in which these operations are performed is the laboratory where the experimental work is carried on.

The output of the company's factory embraces a wide range of sizes, and the purposes for which the cells are

will have impressed the reader with the perfection to which the methods employed have been brought. To Mr. W. W. Gibbs, the president of the Electric Storage Battery Company, much credit is due, for the progressive policy which has imbued the company's work from the start, and Mr. Herbert Lloyd, general manager, deserves



THE CHLORIDE STORAGE BATTERY PLATE.



THE CHLORIDE STORAGE BATTERY.

used are equally numerous. Thus, in one of the rooms, we note the 1000-ampere hour cells, which will be shortly installed in the Edison Illuminating Company's station in New York. At another point we see cells made up into portable groups of two, three and more, for electro-medical purposes. At still another we find a case designed as a portable outfit for a theatrical company, and again sets of small cells 2 x 4 inches, containing three plates, intended to be used in connection with the long distance telephone sets.

As remarked above, the building in which the works are situated has not only been designed especially for manufacturing purposes, according to the best modern practice, but it has also been located so that the raw material brought into the works, and the finished product, can be handled in the most expeditious manner. The works are situated at the intersection of the Pennsylvania and Reading Railroads, and a special siding runs into the court-yard between the wings of the building, so that cars can be loaded and unloaded directly from the level of the delivery platforms. The engraving on page 494 shows a view of the court.

Our somewhat hurried glance at the various processes employed in the manufacture of the chloride accumulator

credit for the excellent manner in which the technical part of the company's work has been carried out in the past, and for the excellent arrangements everywhere adopted in its new home.

STUDENT'S APPARATUS FOR VERIFYING OHM'S LAW.

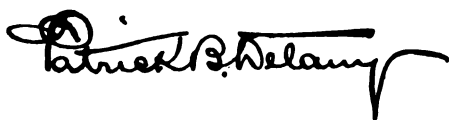
Prof. Ayrton at a recent meeting of the London Physical Society, exhibited a "Student's apparatus for verifying Ohm's law," designed by himself and Mr. Mather. The current flowing through a circuit is to be measured (not necessarily in terms of any defined unit) by means of a galvanometer, while the potential difference between two fixed points is measured by means of an idiostatic electrometer. Within small limits of experimental error the current and potential difference are found to vary in the same proportion; but the electrometer and its manner of use constituted the chief interest of the Paper. The fixed and moving parts (inductors and needle) are alike cylindrical in form (the term being understood in its most unrestricted sense) and the generating lines are vertical. There is a vertical axis of symmetry such that the disposition of these cylindrical parts would remain unchanged if the instrument were rotated through 180° about the axis. The needle is hung by a very thin phosphor-bronze strip, and to obtain a reading when it differs in potential from the inductors by an amount which we have to measure, it is brought back to its ordinary zero position by turning a torsion-head to which the upper end of the suspending strip is fixed. The potential difference is then proportional to the square root of the angle through which the torsion-head has been turned; but the E. M. F. of a moderate battery of accumulators can be read with very fair accuracy. The authors have bestowed great care on the design of the needle, so that, for a given potential difference, the turning-moment divided by the moment of inertia may be as great as possible. The whole instrument is protected from external inductive influence by having the inner surface of its glass case coated with a transparent conducting varnish, which Prof. Ayrton has described elsewhere.

Prof. Ayrton also showed an idiostatic electrometer, whose needle, instead of being suspended, was pivoted on an axle. The instrument is rapid and nearly dead-beat in action, and gives a scale-reading of about three inches for an E. M. F. of 100 volts.

In December, 1884, a communication was sent from New York to London over the Commercial Cable Company's lines and an answer received in 45 seconds. In October, 1894, a similar trial of speed was made over this company's new third cable which occupied 5 seconds.

EXPERIMENTS IN CABLE SIGNALLING.

BY



Within the past few months I have made some experiments in signalling over the Direct United States cable and the cables of the Anglo-American Company, the results of which may be of interest. The trials were mainly with a specially designed system of automatic transmission. Over the Direct cable—Ballinskelligs, Ireland, to Halifax—the entire traffic was transmitted for three weeks under very unfavorable conditions, owing to the almost unprecedentedly severe electric disturbances which prevailed at the time (February last); but the trials demonstrated very clearly, nevertheless, the great superiority of machine working over hand transmission.

In order to get at exact results, on February 27th, during the busiest part of the day, 274 messages sent consecutively were carefully timed, showing the following speeds:—

Number of messages.	Letters per minute.	Number of messages.	Letters per minute.
8.....	88	32.....	85
23.....	91	16.....	88
13.....	95	30.....	87
10.....	86	29.....	88
2.....	91	26.....	87
4.....	84		
88.....	87	274	

Average, 88 letters per minute approximately.

On the morning of March 2d, when the cable was comparatively clear of earth currents, 34 messages were transmitted consecutively as follows:—

Number of messages.	Letters per minute.
7.....	100
5.....	98
17.....	95
5.....	89

Average speed 95½ letters per minute, and without an "R.Q."

The foregoing results were with *regular traffic*, code messages, and under duplex conditions of cable.

Experimentally, code messages sent at 103 letters per minute were repeated back promptly from the recorder slip, while newspaper matter transmitted at speeds ranging from 110 to 120 letters per minute was readily repeated back correctly. I specify two instances of official and careful timing.

February 14th: 268 letters from a newspaper paragraph, comprising figures and fractions of stock market reports, were transmitted at the speed of 111 letters per minute, and immediately repeated back from the strip at Halifax without an error.

On February 14th, 190 letters were transmitted at the rate of 120 letters per minute, and repeated back promptly and correctly with the exception of one word of two letters.

While speeds with actual traffic are the real tests of both cables and systems, it is but fair to assume that these experimental speeds would soon be reached with regular traffic, for experience has proved that after a few months' familiarity with automatic signals, operators read them at a speed 20 per cent. above the speed considered safe at the beginning.

During the month of September experiments were made with the same system over the four cables of the Anglo-American Company—Valentia, Ireland, to Halifax:—

Highest Speed with Regular Traffic.

	Letters per minute.
1873 cable.....	158
1874 ".....	153
1880 ".....	133
1894 ".....	249

These figures require some explanation, however. In-

stead of translating signals into manuscript, the Anglo-American Company cuts the recorder slip into short sections, and pastes them on a blank, so that re-punching or re-transmission by key is done directly from the received record. In order to facilitate this cutting, *three* spaces are made between words in the punching. In arriving at the foregoing results, two extra spaces are allowed for every word of five letters, which is the average for ordinary telegrams, and these extra spaces were computed on the basis of 3.7 impulses to the letter, which is the average shown by the analysis of 10,000 words made a few years ago in France. As a matter of fact, however, *cable* words average about *seven* letters to the word; therefore, extra spaces should be reckoned accordingly. This would modify the foregoing figures as follows:—

	Letters per minute.
1873 cable.....	149
1874 ".....	149
1880 ".....	129
1894 ".....	248

which was the *actual* speed of transmission with regular traffic code messages, carefully timed by officials of the Company at the station.

It is customary to reckon speeds by counting revolutions of the wheel of the transmitter—in which case, of course, all spaces are included; but, unless a stop watch in experienced hands is employed, the count is apt to be inaccurate. A count of the actual letters transmitted during a trial of several hours leaves no room for doubt as to exact results, and as re-transmission from the received strip requires signals which may be read by the average operator without studying, absence of complaint from the receiving station is the best evidence of their legibility. During these experiments at Valentia all signals were judged by the "good for traffic" standard, and the strictness with which this rule was followed was proved by the fact that, except in the case of the '80 cable, none of the speeds reached with regular traffic were exceeded in the experimental transmissions. On several occasions 141 letters per minute, over the '80 cable, were reported "good for traffic," and 146 "fair for traffic"; but after a lapse of a day or two, when traffic was carried, the speed did not rise above 129 letters; the decline might easily be attributed to some change in the adjustments at the receiving station.

Working from London to Heart's Content direct.—An experiment was made with a repeating system arranged by the writer which, judging from the results obtained, foreshadows, it is believed, important changes in cable working in the near future.

Regular traffic was punched in London, and transmitted direct to Heart's Content over the '94 cable as follows:—

September 25th.—24 messages regular traffic, speed 178 letters per minute.

September 26th.—14 messages regular traffic, speed 160 letters per minute. No "R.Q's."

These experiments were hurriedly prepared, but were sufficient to show beyond a shadow of doubt that transmission may be effected from long land lines into ocean cables, at the same speed as the cables are worked from their landing places. London may transmit to Heart's Content, and New York may send direct to Valentia, thus saving repunching, retransmission, and considerable time. So far as transmission is concerned cables may, in effect, be thus extended directly to the great inland centres where the bulk of the cable traffic originates, and this too, without any of the dangerous drawbacks of bad coasts, shore ends, etc., and without any sacrifice in speed by the practical extension.

Working by Sounder across the Atlantic.—For several years the writer has been engaged in devising a system for working long cables by key and sounder, and hoped for a successful demonstration while at Valentia; but, unfortunately, the key-controlled transmitting apparatus sent from London to Heart's Content failed to arrive in

time. With an ordinary Morse key at Heart's Content, however, and a special receiving relay at Valentia, on September 30th Valentia received over the '94 cable on an ordinary Morse sounder 66 letters per minute, and these were automatically repeated to London, who pronounced the signals good. With the special transmitter designed for the experiment I think a speed of 100 letters per minute would have been reached, and I am quite satisfied that this speed can be accomplished between New York and London through automatic repeaters. I am strongly of the opinion, however, that in the near future all long cables will be operated by the automatic machine system of transmission.

ELECTRICAL MACHINIST PRACTICE.—XIV.

BY

James F. Hobart,

I have been taking lessons in armature balancing during the past few days, and have witnessed that operation in half-a-dozen different shops. The result of my observations leads me to believe that there are many things in connection with armature balancing that it is "well not to do." There are certain other neglected things that could be done to great advantage. Some of these methods will be the subjects of illustration in the next paper of this series. I will only add here that an engineering journal recently printed a short article upon the subject of "Why do Armature Shafts Break?" If the writer thereof had seen all the *balancing methods* I have gazed upon during the past few days, he would exclaim:—"Why don't more armature shafts break?"

Some of the "refinements of testing," as observed in the various shops, are always interesting and amusing. Sometimes they are very instructive as well. I have frequently made the statement in these columns that magneto testing was not the most desirable method that could be employed, yet there are many schemes in use beside which magneto testing is as perfection itself. In street railway work, testing is frequently done by touching the parts to be tested with the terminals of a circuit in which five lamps in series have been placed. This does pretty well for testing starting rheostats, etc., but when it comes down to testing commutators in a similar manner, but with 110 volts, it is quite a different thing. By touching a wire to each segment in succession, and giving a drawing, or scratching motion to one of the wires, a series of sparks or arcs is developed between the wire and the segment whenever there is any short circuit between them.

That such a rough method of testing should be tolerated is surprising, especially when it is not for the lack of instruments, as, in one shop where this method is in use, I noticed another man at the same time, testing arc lamp coils with a fine bridge to which a reflecting galvanometer was attached! Quite a contrast, and surely a greater one than there is any need of.

Every machine shop ought to have a fine large vise for heavy work. Especially should the electrical machine shop have such a tool. For unscrewing commutator nuts, nothing is handier than a stout vise put where it can be got at by everybody. Fig. 66, shows a vise put up in a manner worthy of being imitated. In a well known New York electrical repair shop, a big post comes up through the floor and extends to the roof. To this post, as shown in the engraving, the vise is attached by means of bar iron four inches wide and one inch thick. The block, 4 inches thick, should be of hard wood. Pine is too soft and is apt to leave the vise loose. The brace is a very necessary attachment and should not be omitted by any means. Only one brace is used, and that is put on the right-hand side, where it will be out of

the way when screwing up a commutator; that and similar work being done at the left-hand side of the vise.

In connection with this tool, which is perhaps the best, and certainly the strongest one in the shop, the device shown at *a* is frequently used with good results. Even when a vise is new, it is hard to hold large cylinders in it, but a piece of old bastard file *b*, put between the vise jaw and the work *c*, will make a hilt that two men on the end of a six-foot wrench cannot budge. Evidently a set of jaws something like those used for holding pipe, would be desirable, but when commutators from two to ten inches in diameter must be handled in the same vise, it would need a number of jaws of various sizes to do the work now done by that little piece of file.

An "electrical coil winder" was illustrated and described in the issue of Nov. 7 (paper VIII.) which has proved a great convenience to its users, and the winding device, driven by belt, illustrated in Fig. 67, is a form of winder much used for heavy work, such as field coils and the larger armature coils, especially the kind wound upon forms and then detached and taped before being placed bodily upon the armature core. A counter shaft *c* is placed a short distance above the bench *f*, the object being mainly to secure a short belt between pulleys *b* and *c*. The weight of a long belt is objectionable, and the movement of the

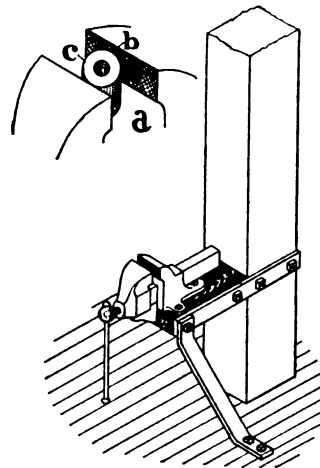


FIG. 66.

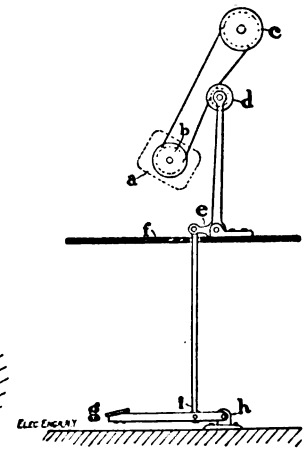


FIG. 67.

tightener *d* must be greater with a long belt, than a short one.

The form *a* upon which the coil is to be wound, is placed on an arbor which projects beyond its bearings, emery-grinder fashion. Pulley *b*, is on the same shaft, but between the bearings. Power is applied to idler *d* by means of the foot lever *g*, which is fulcrumed at *h*, and connected by the rod *i* with the bell crank *e*, to the upper end of which the tightener pulley is attached. It will be noticed that no spring is used for throwing off the binder pulley when pressure is removed from *g*. If the levers are properly arranged, there is no need of a spring, the tension of the belt being sufficient to throw *d* back until it is past a vertical position. Then, the weight of *d* being just about sufficient to balance the weight of lever *g*, there is not only no need of a spring, but the binder will stay about where it is left when the foot is removed. The binder is arranged so as to bear upon the *slack* fold of the belt, and pulleys *b* and *c* should be nearly equal in diameter to ensure easy working.

ARMOUR INSTITUTE, CHICAGO.

Mr. F. A. Hamilton, A. I. E. E., recently gave an interesting lecture before the electrical students of Armour Institute, on the subject of "Submarine Cables and Cable Laying." It was fully illustrated by lantern slides, made from original sketches and charts. Mr. Hamilton was for sixteen years Electrician-in-chief to the Anglo-American Telegraph Co.

THE ELECTRICAL ENGINEER.

(INCORPORATED)

PUBLISHED EVERY WEDNESDAY AT

203 Broadway, New York.

Telephone: 1323 Cortlandt.

Cable Address: LENGINEER.

Geo. M. Phelps, President.

F. R. COLVIN, Treas. and Business Manager.

Edited by

T. COMMERFORD MARTIN and JOSEPH WETZLER.

Associate Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue, Boston, Mass.

Western Editor and Manager, C. KAMMEYER, 1439 Monadnock Building, Chicago, Ill.

New York Representative, 203 Broadway, } W. F. HANKS.
Philadelphia Representative, 916 Betz Building, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada, - - - - -	per annum, \$3.00
Four or more Copies, in Clubs (each) - - - - -	2.50
Great Britain and other Foreign Countries within the Postal Union - - - - -	5.00
Single Copies, - - - - -	.10

[Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1888.]

EDITORIAL ANNOUNCEMENTS.

Addresses.—Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of THE ELECTRICAL ENGINEER. Communications for the attention of the editors should be addressed, EDITOR OF THE ELECTRICAL ENGINEER, 203 Broadway, New York City.

Communications suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.

VOL. XVIII. NEW YORK, DECEMBER 19, 1894. No. 346.

CONTENTS.

EDITORIALS :—	PAGE
Some Factors in the Construction of Continuous Current Machines.....	498
Increased Speed in Ocean Telegraphy.....	499
Trolley Car Speeds.....	499
ARTICLES :—	
The Louisville, Ky., Electric Light Company's Extension. (illustr.).....	499
The Manufacture of Chloride Accumulators. (illustr.).....	491
Experiments in Cable Signalling..... F. B. DELANY.	496
Electrical Machinist Practice.—XIV. (illustr.)..... J. F. HOBART.	497
Direct Current Motor and Dynamo Design.—II. (illustr.) (Concluded.)..... GANO S. DUNN.	501
Aluminum Leading in Wires for Incandescent Lamps. (illustr.).....	508
Cotton States and International Exposition (illustr.).....	504
ELECTRIC TRANSPORTATION DEPARTMENT :—	
More Trolley Traction for New Orleans.—Single Track Elevated Electric Railway for Berlin.—Waddell-Entz Storage Cars in Vienna.—Single Motor Equipments.—New Electric Railway in Kingston, N. Y.—Railway Litigation in Trenton, N. J.—Railway Work at Newtown, L. I.—Electric Railway Work in Ohio.—Receivership of the Suburban Traction Co.—General Electric Railway Apparatus for Boston.—New Jersey Traction Co.—Increased Business of the Philadelphia Traction Co.—Staten Island Electric Railroad Co.—Street Railway Consolidation in Pittsburgh.—The Zédé Submarine Boat.....	500
NEWS AND NOTES :—	
Students' Apparatus for Verifying Ohm's Law.....	495
"Science,".....	505
"L'Éclaircie Électrique,".....	499
PERSONAL :—	
Prof. George Forbes.....	508
Prof. S. H. Short.....	508
LETTERS TO THE EDITOR :—	
Armature Disc Cutting..... J. F. HOBART.	508
Multiple Armature Windings..... S. S. WHEELER.	508
Early Morning Test in Telephone Offices..... J. W. MANSON.	508
LITERATURE :—	
Perry's "Electric Railroad Motors".....	504
MARRIED.	
Insull-Van Vliet.....	504
SOCIETY AND CLUB NOTES :—	
American Institute of Electrical Engineers.....	504
Brooklyn Institute.....	504
National Electric Light Association.....	505
INVENTORS' RECORD :—	
Classified Digest of U. S. Electrical Patents Issued Dec. 11, 1894.....	505
TRADE NOTES AND NOVELTIES AND MECHANICAL DEPARTMENT :—	
Commercial Electric Company's Multipolar Generators and Motors, (illustr.)—Warren Webster & Co.—Western Union Revenues.....	506
Ford & Smith.—Enlarging the General Electric Works at Schenectady.—New 800 K. W. General Electric Alternator for St. Louis. (illustr.)—Sales of La Roche Apparatus.—St. Louis Iron & Machine Works.....	507
Bidding on Plant for the Dayton, Ohio, Hospital.—New York Edison Earnings.—Standard Electric Co.—The Storage Battery Consolidation.—New York Notes.—Western Notes.....	508

SOME FACTORS IN THE CONSTRUCTION OF CONTINUOUS CURRENT MACHINES.

THE literature of dynamo and motor construction is so voluminous, and the points which have to be considered in the design of machines have been so thoroughly discussed that few can hope to take up this subject again and bring out anything novel. This, of course, speaks well for the ingenuity displayed in the past by designers, but, on the other hand, the statement carries with it the implication that we have almost reached finality in this direction. To assert the latter so broadly would, we believe, not only be far from the truth, but contrary to the teachings of experience. That improvements are possible and that developments are constantly under way to meet new conditions is well shown in the admirable lecture delivered by Mr. Gano S. Dunn, before the New York Electrical Society, which we conclude this week. Leaving aside the question of efficiency, the most important attribute of electro-dynamic machinery is its non-sparking property, for, while the former involves the question of coal consumption, the latter involves the very life of the machine itself; and while the user may be in blissful ignorance of what is going on in the boiler room, he cannot be blind to the destructive action going on at the commutator. Mr. Dunn very properly dwells at length on this point and shows the two principal methods by which sparking can be suppressed, the one by means of forced commutation and the other by the application of a brush of a proper resistance. The latter point we believe to be one which has not received the attention its importance merits, which is all the more strange when we consider the excellent results obtained with carbon brushes since their introduction. That there is a brush resistance best adapted to each potential seems to be well established by past practice, and this fact may, as Mr. Dunn points out, lead to the better control of direct current machines destined for high voltage, the sparking of which has been one of the deterring factors in their application in many instances where they would appear to be well adapted for power transmission. With respect to the design of compound wound generators, Mr. Dunn makes a most valuable suggestion in advocating the use of the variable shunt made of iron, instead of the German silver strip heretofore employed. He shows very clearly how a shunt having a fixed value requires that the machine should possess a large amount of iron and be worked at a low degree of saturation, in order to obtain an increase of potential uniform with increase of load. The heated iron acts automatically as a variable shunt, in the true sense of the term, and hence allows the iron of the fields to be worked at a much higher magnetic density than has heretofore been possible. It is probable that this method will be more applicable to compound machines designed for lighting where the load is tolerably steady than to railway generators, but its use for that purpose alone offers a wide field of application.

There is still another point in Mr. Dunn's lecture that is frequently lost sight of that concerns the purchaser of the machine as well as the designer. The latter can make the efficiency of a machine anything he chooses up to a certain limit, but it by no means follows that the machine

having the highest possible efficiency has the best all-day efficiency, taking into consideration the variability in the load under which, as a rule, dynamo-electric machinery is operated. The results of actual tests on several hundred motors, for example, have shown that the average load did not exceed 30 per cent. of the maximum power of the machine. Under such conditions, a motor having 90 per cent. efficiency at full load and 70 per cent. at a quarter load would not be as economical as a machine having, say, 88 per cent. at full load and 80 per cent. at quarter load. High full load efficiency, of course, is a most desirable thing in a motor, but its attainment must always be, to a great extent, at the sacrifice of the efficiency at lighter loads. We are fully aware of the difficulty of convincing the intending purchaser of the point here involved, but to those who are operating motors on a meter, the argument which the monthly bill affords will be stronger than the persuasive powers of the motor salesman, however enthusiastic the latter may be. We can heartily commend Mr. Dunn's paper to the attention of designers and users of dynamos and motors.

INCREASED SPEED IN OCEAN TELEGRAPHY.

THE laying, within the last few months, of two heavy Atlantic cables whose speeds of working have been raised to a pitch hardly dreamed of a few years ago has served to draw attention to the general subject of signalling speed in cables. But while the construction of these new cables marks a distinct advance it has also stimulated efforts to increase the speed of the older existing cables, which, in the belief of not a few, are not being worked to the capacity that can be got out of them. Automatic cable signalling, indeed, is now the order of the day, and hence the recent experiments in cable telegraphy made by Mr. P. B. Delany over Atlantic Cables are of special importance at this time. With his system of automatic transmission Mr. Delany has demonstrated that long cables may be operated at a speed 25 per cent. higher than heretofore, and that it is practicable to transmit from London to America or from New York to Europe direct without rehandling the message at the ends of the cables, thus saving considerable time and greatly simplifying the work. Mr. Delany has also shown that Atlantic cables may be operated by the Morse system if desired, and that New York may work direct to London by sound. We agree with Mr. Delany's opinion, however, that in the near future all cables will be operated by automatic or machine systems, as cables cost so much to lay down that their carrying capacities cannot be restricted to the ability or expertness of an operator to manipulate a key. Besides, signals transmitted by machine are always uniform while hand signals follow the vagaries of the operator. With a machine sending impulses of absolutely uniform duration and making the best division of time between the cable and the current and the cable and earth, operated in connection with a siphon recorder to write down the signals at the receiving end, it would seem that the highest efficiency in cable signalling had been reached; and Mr. Delany is to be congratulated not only upon the great increase in speed obtained by his system, but upon the successful operation of Ocean cables in connection with land lines of

great length. Before his recent return from England, Mr. Delany contributed to the London *Electrician* the article with a copy of which he has now furnished us also; and in commenting upon the work done, our excellent contemporary remarks, aside from criticism of certain details: "He seems to have accomplished two things at which submarine cable men have long aimed, namely, the use of Morse sounders on a long cable; and the abolition, where such abolition is found to be useful, of the cable station."

TROLLEY CAR SPEEDS.

FROM time to time one notes the outbreak of an agitation in some city or another for the limitation of trolley car speeds. Brooklyn has recently been going through the experience, just as Buffalo did two or three years ago, and with like result in the decision not to make the cars go slower than they now do. The fact is, as Mr. Parshall pointed out recently in London before the Institution of Electrical Engineers, accidents occur pretty much inversely as the speed of the car, and are more numerous in the crowded portions of a city where the cars run very slowly, than in the suburbs and outskirts where they make 12 or 15 miles an hour. In reality, the speed of the cars has little to do with it. But there will always be a certain proportion of stupid, careless, nervous and infirm people in the mass of street foot passengers, as well as a number of heedless children, and it is a proper and merciful object to guard them as far as possible from the effects of their own absence of self-preservative ability. Carfenders are, of course, one means to this end, and far better than cutting down the speed; but the obvious remedy, now certainly available, is to apply high class brakes to the car. Anyone who has watched the marvelous quickness of these modern brakes in bringing a fast car to a standstill, must have realized that here was the cure for the trouble without sacrificing any of the great boons of swift comfortable travel that trolley rapid transit is conferring on every large and busy city in the Union. It is an absolute waste of money to equip a road with first-class electric apparatus, and then to have it condemned to a low rate of speed because there is a want of control power. Moreover, the reduction of speed, while wasting the time of the passenger, inflicts on a company the cost of an unnecessary equipment perhaps 30 to 50 per cent. larger than it would otherwise be. These are serious considerations, and while we sympathize with the occasional outbursts of public feeling against high dangerous speeds, we do feel that the companies would hear less complaint and encounter less opposition, if it were known that the braking of the cars was all that it should be; while they who use the cars would be solicitous for the highest speed then shown to be consistent with safety.

L'Étincelle Electrique is the name of our latest French contemporary. It enters the ranks to satisfy the popular craving for electrical news served up in an elementary way and the first few numbers before us indicate that it accomplishes its object fairly well. Under the head of "Réflexions d'un Profane," electrical topics of the day are discussed in a piquant way. The new journal is published at Paris, by Alcan-Lévy, 24 Rue Chauchat; price, 15 francs per annum.

ELECTRIC TRANSPORTATION DEPARTMENT.

MORE TROLLEY TRACTION FOR NEW ORLEANS.

The Orleans Street Railroad has voted to give up mules for electricity. It has $9\frac{1}{2}$ miles of road and 32 cars, and will spend about \$200,000 on the change. P. Cougot is president; and L. M. Petitpain secretary and treasurer.

A SINGLE TRACK ELEVATED ELECTRIC RAILWAY FOR BERLIN.

A "hanging" electric railway is proposed for Berlin. It is to consist of an iron network, with iron rails supported by columns at equal distances, each passenger car to be suspended from two small wagons running on these rails.

WADDELL-ENTZ STORAGE CARS IN VIENNA.

Two Waddell-Entz storage battery cars, similar to those operated recently on the Second avenue surface road in New York, have been sent to Vienna, Austria, where they will be tested by a commission of representative electrical and civil engineers. The cars will be operated on a road now run by steam and will thus be enabled to run at high speeds.

SINGLE MOTOR EQUIPMENTS.

Mr. W. H. Sinclair, president of the Galveston, Tex., City Railroad Co., writes us that they are using single motors on all their cars with satisfactory results. The motors are of Westinghouse make. There has been an impression that the experience at Galveston showed that single motors to a car were a failure, but this report proves exactly the reverse.

NEW ELECTRIC RAILWAY IN KINGSTON, N. Y.

The Colonial City Electric Railroad of Kingston has been opened with a great public demonstration. The road as yet has but three cars and an injunction procured by the West Shore Railroad prevents the tracks of the latter from being crossed, so the new road will be operated in two sections for the present, but despite the opposition, the public is enthusiastic and the road is expected to succeed.

RAILWAY LITIGATION IN TRENTON, N. J.

A temporary injunction has been obtained in the Court of Chancery restraining the proposed sale of the Trenton Passenger Company to the Trenton Traction Company. The injunction was obtained by Samuel K. Wilson, vice-president and owner of \$500,000 worth of stock. The road is mortgaged for \$100,000. Forty thousand dollars' worth of its paper has just been protested.

RAILWAY WORK AT NEWTOWN, LONG ISLAND.

The Highway Com. of the township of Newtown granted Dec. 12 to the Brooklyn, Newtown and Bowery Bay Railway Company a franchise to operate a road from Green Point to the Lutheran Cemetery and Bowery Bay. A. C. Combes, of Newtown is president, and Edward B. Gallaher, M. E., of 253 Broadway, New York, who is also engineer for the Peekskill Road, has full charge of the construction work.

ELECTRIC RAILWAY WORK IN OHIO.

The Mahoning Electric company of Niles, Ohio, capital \$150,000 has been incorporated by C. F. Clapp, R. G. Sykes, Arthur A. Anderson, G. E. Herrick, Andrew Squire and John E. McVey, the latter three of Cleveland. They will build a line over the highways from Niles to Girard in Trumbull county, and to Youngstown in Mahoning county.

The Ravenna Electric Street Railway company was also incorporated at the same time by George H. Westington, William J. Akers, George W. Gardner, J. H. Evans and R. B. Carnahan. The capital is \$50,000.

RECEIVERSHIP OF THE SUBURBAN TRACTION COMPANY.

Vice Chancellor Van Fleet has appointed Watson Whittlesey, on the application of the American Loan and Trust Company, of Boston, receiver of the Suburban Traction Company, of Orange,

N. J., bonds of which corporation to the amount of \$1,500,000 are held, by the Loan and Trust Company. The Traction Company's property was to have been sold to satisfy judgments against it, but the American Loan and Trust Company secured a temporary injunction postponing the sale. Mr. Whittlesey furnished bonds in the sum of \$30,000. The total debt of the Traction Company above its bonded indebtedness is \$140,945.56.

GENERAL ELECTRIC RAILWAY APPARATUS FOR BOSTON.

The West End Electric Railway has placed a contract with the General Electric Company for fifty-five electric car equipments, or one hundred and ten motors, at a cost of \$45,800.

NEW JERSEY TRACTION CO.

The New Jersey Traction Company has finally secured a franchise from the Clinton township committee of Newark, N. J. to lay tracks in the centre of Frelinghuysen avenue, to connect with the Elizabeth branch. The construction of the road from Newark to Elizabeth will be begun at once, connecting the road through from Jersey City to Elizabethport, a distance of fifteen miles, for the single fare of fifteen cents. It is now thought that Elizabeth will have trolley cars before February 1. They were promised last July.

INCREASED BUSINESS OF THE PHILADELPHIA TRACTION COMPANY.

The annual report of President P. A. B. Widener of the Philadelphia Traction Company shows that during the year ending June 30, 1894, 186,327,329 passengers were carried, an increase of 10,692,794, as compared with the previous year. The total receipts were \$5,194,990.52 and the expenditures \$4,702,416.70. Since the introduction of the trolleys the increase in revenue has averaged about \$50,000 per month. All the officers have been reelected for the ensuing year.

STATEN ISLAND ELECTRIC RAILROAD COMPANY.

Papers have been sent to Albany for the incorporation of the Staten Island Electric Railroad Company. This company has planned to run a trolley road twenty miles long through Staten Island, to connect with the Staten Island ferries. The company will have \$1,250,000 capital, and numbers among its incorporators Gen. S. L. Thomas and T. F. Ryan, both of whom are directors in the Staten Island Ferry Company. It is said that the new plan is a scheme of the Broadway Cable road to connect with the Staten Island line, and thus place itself in a position to dictate terms to the Ferry Company.

A director of the Staten Island Rapid Transit Company ridicules the idea, saying that such a road would not get enough traffic to pay one-fourth its expenses.

STREET RAILWAY CONSOLIDATION IN PITTSBURG.

The details of the biggest street railway consolidation ever effected in Pittsburg have been completed. The new system, under the name of the Second Avenue Traction Company, will be in operation by Jan. 1, and has a paid-in capital of \$5,000,000. There are four branches, with a total of sixty miles of track. The main line extends from Market Street, Pittsburg, to McKeesport, a distance of ten and a half miles. This distance will be traveled in forty-five minutes, and the fare will be 20 cents. A power house of 22,000 horse power is now nearing completion at Glenwood. On the line the company has purchased a large farm, which will at once be changed to a park. James D. Callery is President of the new company.

THE ZEDE SUBMARINE BOAT.

Towards the end of last month the French submarine torpedo-boat Gustave Zédé began her trials at Toulon. She is a cigar-shaped vessel, 131 ft. long, and displacing, when submerged, about 266 tons. On one test she moved about the roadstead for three hours, never, however, as far as could be seen by those who were watching her from the shore, going beneath the surface. She attained a speed first of about five knots, and subsequently of about eight knots, with the 800 new accumulators with which she has recently been fitted. It appears that, although the boat was probably not submerged for a single moment, those on board experienced some discomfort from the acid vapors.

DIRECT CURRENT MOTOR AND DYNAMO DESIGN.—II.

(Concluded.)

BY GANO S. DUNN.

The next feature I wish to speak about is sparking and armature reaction. Sparking is the phenomenon of sparks at the brushes of a direct current machine due to the self-induction of the coils. There are a number of forms of sparking which are not due to that at all. If this commutator here were full of ridges it would spark; but those can be easily turned off. If the brushes are too small it will spark; but they can be made larger. These are not inherent difficulties; they are merely matters of construction. But if we construct these at our best, we will always have the sparking which I have just defined, due to the self-induction of the coils. The reason for that you are familiar with. It is shown in the diagram, Fig. 5. It is at the moment of change of the direction of the current, that we get the spark, the same as we do in an induction coil when we start or stop a current in it; and this coil has a certain amount of electrical inertia that will not submit to being reversed suddenly. It has got to take a little time and the spark shows. Now a large portion of the design of direct current machinery is nothing else than provision that the machines shall not spark. There are two methods by which we can stop the sparking. The first method is by forced commutation. The second method is by means of an electromotive force applied to the coil which is at the moment having its current changed. This electromotive force helps it to change quickly. Forced commutation is the means of killing the spark by resistance of brushes. The coil A, Fig. 5, has no current in it. But as the armature is revolved, pretty soon the toe of the brush will leave the commutator bar b. Then the brush will bear only upon the commutator bar c. Thus, half the current will be obliged to go through the coil A in order to get through that half of the winding marked L, and the other half will come down to R as usual. Now if that coil A can be prepared so that when its turn comes to take its place with the rest of the winding it can have the current already flowing in it of the same quantity as the current in its new position, then on leaving the toe of the brush, at that bar b there will be no sparking. Now that can be done in forced commutation by having the resistance of the brush sufficiently high. As the commutator moves and the brush touches less and less of the bar b, the current finds it harder to get into this commutator bar than into c, so it begins to overcome the electrical inertia and go up the coil A gradually from c. By the time b has moved from under the brush the whole current will have been gradually throttled to go out of bar b and forced to go up into the coil A and there will be no sparking.

To put carbon on some machines is very bad, because it has so very much higher resistance than copper that it uses up the power of the machine, and therefore other materials have been very much sought for. The copper brush is made with many laminae so that the current that comes down through the brush cannot all get squeezed into that little toe. It cannot get into that toe unless it is started into it at the top of the brush, and if it is started into it at the top there is an appreciable resistance. If that resistance is not enough we resort to the copper gauze brush, which has a much higher resistance than a copper leaf brush, and while there are some mechanical advantages in using it, such as cooling effects, yet the principal reason it stops sparking is that it has higher resistance. If this is not high resistance enough we go the next step, which is a brass gauze brush having about twice the resistance of copper gauze. If that is not enough we take the next step. That is some form of carbon which has

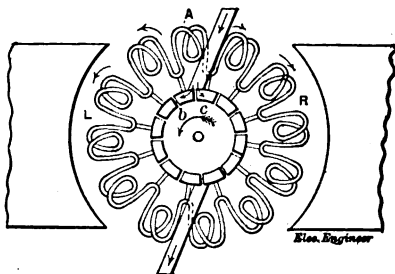


FIG. 5.

its resistance reduced. Ordinary carbon cannot have its resistance reduced. But all sorts of inventions have been made, such as putting fine filings in the brush, and in this case the brushes are made with layers of gauze molded in them, so that the gauze helps to increase the conductivity of the brush. After that comes the pure carbon, and if that is not of high enough resistance it can be made as high as desired by mixing clay with it. The resistance of brushes ought to go up as the voltage of the machine goes up. I have had in mind, but have not had the time to carry them out, experiments to determine just what the law is.

I believe it should go up as the square of the voltage, and that by making our machines on that basis and considering the resistance of the brushes just as much a part of the design as we do the resistance of the armature windings, we could build very large machines of very high voltage without sparking. I do not see why the resistances could not be just right so as to squeeze all of a 10,000 volt current over into the bar following before the break takes place.

In connection with this there is one thing that we have forgotten. If we do that squeezing and throttling, it heats the commu-

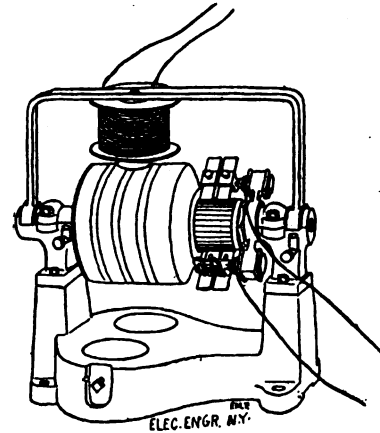


FIG. 6.

tator and if the commutator is too small its temperature rises. It decomposes the carbon brush; it gets black and the machine is rendered unfit for use. If you are going to determine on forced commutation you must then have a definite ratio of commutator surface for every horse power in your machine. That is as true as the fact that the resistance of your brushes should go up with your voltage.

So much for forced commutation. The other method of stopping sparking is by applying an electromotive force to the coil A, just as it comes out of circuit, so that by the time it comes into circuit it shall have its current. Applying electromotive force means that you have a little dynamo working to get up the current so as to have it ready. Now that electromotive force will be applied by the magnet held in my hand and I will endeavor to show you how it will work. (Mr. Dunn started the machine.) This is an armature which has not any field acting on it at all. It seems to me that sparking can be understood better if we talk about it entirely separated from the field magnets. So I have an armature here which is simply revolving in the air. Now I am going to pass its normal current through it and will show you that it sparks. This has not forced commutation because it is a copper brush. Neither is it prevented from sparking by the electromotive force, because there is none acting upon it. To spark is the normal, natural condition of the armature. I have here a carbon brush which will stop the sparking by virtue of its resistance and will be an example of forced commutation. You see the sparking is killed by virtue of the resistance of the carbon brush.

Now I will show a method of killing the spark on this copper brush by means of the electromotive force applied.

I have here a magnet, Fig. 6, which is energized from the circuit and which will throw out a few lines of force. I will apply it to the armature in the region of the brush and you will see the sparking disappear. (The armature, Fig. 6, is supposed to be driven by another motor.) It may happen that the polarity of this is wrong when I put it on and it may make the current in the coil go the wrong way so that when it is thrown into circuit it will have to stop the current that is flowing wrongly and then start a proper current and the sparking will be increased. (Applause.) The polarity is right and you see the sparking disappears.

Now I am going to give this not quite enough electromotive force to bring its current up equal to the current in the rest of the armature. I will do that by moving the coil a little to one side. The sparking appears again. Now I am going to give it too much, so that the current generated in the coil under the brush is too big for the rest of the circuit. Now it is equal to it, and there is no sparking; now it is too big, and the sparking appears again.

Sometimes it happens that an armature with brushes at the neutral point sparks worse than it would if it were let alone. This is because the magnetism from the opposite pole comes over and increases the spark. It is drawn over apparently by the revolution of the armature. That condition can be imitated by reversing the polarity in this coil. I will first reduce the sparking to zero by this electromotive force. Now I will reverse the direction in the coil. The effect is vicious sparking.

You have seen how an electromotive force will stop sparking and you have also seen how resistance in the brush will also do it. Now the commutation of every machine that is built takes place

by means of one or the other or a combination of these devices. The larger the machine, the more difficult it is to adopt forced commutation because the excessive heating of the brushes causes the commutator to overheat. To design a dynamo so that it will not spark,—a dynamo of any size,—is merely so laying out its magnetism that it will always get a little squirt of lines of force right in the brush. Now you see me moving this coil towards its brush to stop the sparking. But what you do in an actual case—you cannot move the magnets or you cannot move a little coil like this—is to move the brush so that it comes under

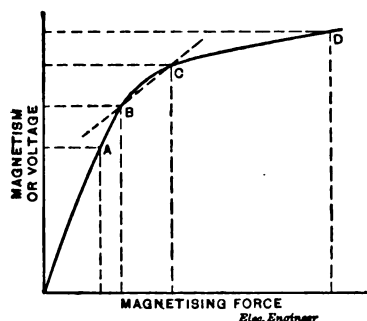


FIG. 7.

the edge of the big magnet of the machine and that accomplishes the same result. That is why shifting brushes stops sparking. It enables you to get a little fringe of magnetism which trails off the toes, and does the same thing that you saw this little coil do.

There are reactions that oppose the coil and there are also reactions that oppose this action at the toe of the brush. Before you shift brushes you may have a fringe of magnetism that would stop the sparking if it could get at it. But by the time the brush is moved towards it that motion of the brush has induced reactions into the circuit which have driven back the magnetism. A very important point in dynamo designing is the providing that magnetism shall not be driven away. To show you one of the reactions that tends to drive away that magnetism, the next experiment is arranged.

Here is a motor that would normally run forward. As you see, it has no field coils on it, so any magnetism that it may get to run it will have to come from the armature. Now, as I said, it would naturally run forward if it were working with the magnetism generated by its field. Now I will put the armature current alone through it,—its regular current that it would have ordinarily,—and you will see how it runs. You see it runs backwards. That is what the armature would do if it could in any motor. The fields have to be strong enough to overcome that tendency, and besides overcoming it to give sufficient magnetism to make the armature go forward. That is one of the things that destroys whatever little fringe we have to reverse our coils and prevent sparking. The machine is now running simply on the reaction field produced by the armature. There are no coils on the machine. This reaction is due to the negative ampere turns of the armature. It is easily calculable, and what we have to do is to make the magnetism that comes up this magnet of such strength that it goes through the big air gap offering so much resistance to it that the little extra resistance offered by that reaction on the armature amounts to nothing in comparison, and so that when the armature offers this resistance we still have our little fringe of lines of force which act as the little coil did to stop the sparking.

In a motor we shift the brushes back to stop sparking, because the proper polarity of fringe comes out of one pole, and in a dynamo we shift the brushes forward to stop sparking because the proper fringe comes out of the other pole.

A method of increasing the resistance of the air gap is, in the toothed armatures, to make the teeth very narrow. Here is a toothed armature of a four pole machine. All the magnetism that gets into this armature has to get into it through these teeth, under about 70 degrees of pole piece. You can see that the sum of these teeth are not enough to carry all the magnetism that would go through that core. The result is that the magnetism is squeezed so hard that the reaction of the armature does not amount to much. This effect that I showed, of a motor running backward, will do the same thing as the winding attributed to both Ayrton and Perry, and Sprague, will do. If the conditions are right we could have a motor, even with fields on it, such that its reaction will be such in proportion to the effect of these fields, that while the armature will not run backwards when the load comes on yet it will so weaken the field magnets that the armature speed will increase. I have known instances of this, and it can be secured by a little proportioning of the armature, very easily and without any other winding. All the benefits, whatever they are, of the winding of Ayrton and Perry and of Sprague could have been secured by proportioning their armatures, with-

out going through the expense and trouble and elaborate calculations of the differential motor winding.

One more feature that I wish to call your attention, relates to compound winding of dynamos. That problem is a serious one and is more so than it used to be. A compound wound machine, as you all know, is a machine which, when the load comes on, instead of having its pressure fall off a little, as everything does,—steam engines, water wheels, all slow up and pull down a little bit when the load comes on,—will have its pressure rise a little. This rise is for the purpose of compensating for loss of pressure in the line. Now if you are lighting a number of lights at a distant point, and when you have all your lights burning let us assume that you get 10 per cent. less pressure at your lights than you would if you had only one of them burning. A compound wound dynamo can be made so that as fast as the pressure falls, due to—call it friction of the current in the wire—the dynamo increases its pressure to make up for that with the result that your lights have always a constant pressure. The voltage at your dynamo rises but your lights are constant. We ought to have this so that at half load the increase of potential would be half of the increase that we have allowed for, and with three-quarters it would be three-quarters, and at full load it would be the full increase. That is impossible to attain exactly.

The rise of voltage must be obtained by increasing the magnetism of the machine as the load increases. Suppose we want an increase of ten per cent. in voltage. If we start at C, Fig. 7, we can increase the magnetism and at D will have ten per cent. more magnetism than at C. But notice at what a sacrifice we have had to more than double the magnetizing force. Not only does that reduce efficiency, but it means double the amount of copper. But the curve from C to D is straight and at half load we get half the increase of potential and at full load a full increase.

If I should work in the region between B and C then at half load we would get a good deal more than half the increase of potential wanted. So we cannot work on that part of the curve; that would injure the lights. Now if we work down on the point of the curve where it is straight again from A to B we secure the results of an even increase of potential. But here we have a machine which we are working at a saturation B and all the capacity from B to C is wasted. In other words, we have to use considerably more iron in that machine in order to saturate the iron at so low a degree as will allow its curve to be straight, and that makes the machine much more expensive, and less efficient, because we have copper wire around that iron which gives rise to a great many disadvantages. Now I have devised a method for enabling this portion of the curve B to C to be used with a straight rise of potential. The custom of builders is shown in Fig. 8. One engineer will specify that he wants a two per cent., another a three per cent., another a four per cent., another a $7\frac{1}{2}$ per cent. increase of potential. The manufacturer cannot meet all those demands, so he winds every machine for, say, 10 per cent. increase of potential, and Fig. 8 represents a machine so wound. The coils B are the shunt winding. The coils A are the series winding. The current as it comes out of the armature goes in around the series windings and then out to be used. It will be seen that at no load the series coil is not excited at all, while at full load it gets a good many amperes through it and that increases the magnetism enough to make up for losses and raises the potential. If this machine is wound for 10 per cent. over-compounding and a user orders 5 per cent. over compound-

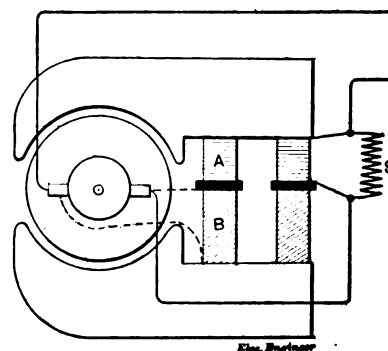


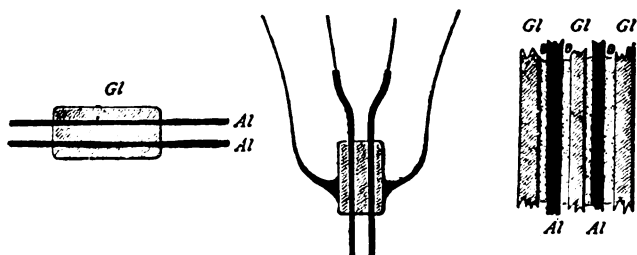
FIG. 8.

ing, it is the custom of the manufacturer to insert a shunt S. Whereas the whole current would, previous to the addition of the shunt, have gone through the coils A and out and given ten per cent. increase, now the current divides equally between the coil and shunt and gives only 5 per cent. increase in the magnetism. It has been customary to make this shunt of some material whose resistance is fixed, so that if a user ordered 5 per cent. he would get a 5 per cent. distribution at all times and it was considered bad to have this changed. The shunt was also made very large to keep it cool. By making this shunt, not of German silver, as

is customary, but of iron which has a very large temperature coefficient, and then, instead of making it large, making it very small, so that a small amount of energy will heat it up and change its resistance as much as possible, we can at full load throw into the series coils a good deal more than the proportion they would get at light load. That extra current, if the increase of magnetism were proportional to increase of magnetizing force, would tend to make the increase of potential follow a curve convex downward. Now the increase of magnetism tends to follow a curve whose convexity is upward and the shunt tends to go up, so the result is the potential rises along a resultant of these two which can be made a straight line. But there is this proviso,—you must wait for the shunt to get hot. If you put a sudden load on the machine for five seconds and then take it off again, the rise of potential will follow the straight line. We could inclose the shunt in a vacuum so that it would reach its temperature in half a minute. If the generator were for lighting, the load would not change suddenly and therefore the increase of potential could be counted on to be practically proportional.

ALUMINUM LEADING-IN WIRES FOR INCANDESCENT LAMPS.

A PLAN to replace platinum by aluminum, to the use of which metal objections based on rarity are not now very likely to apply, has been suggested by Mr. Werner Bolton, who exhibited lamps made with the substitute, at the recent meeting of the German Electro-Chemical Society in Berlin. The coefficient of expansion of aluminum is much larger than that of glass, and direct sealing-in is impracticable. The joint between glass and metal is, however, made in the following ingenious manner. The aluminum is heated in a glass tube until it fuses and the envelope of glass fuses round it. When the composite rod (having a glass envelope and an aluminum core) cools, the glass cracks; but this is of no moment, as the function of the glass is merely to prevent the



FIGS. 1, 2 AND 3.

aluminum melting when it comes to be sealed into the thick glass envelope which ultimately forms the base of the lamp. The arrangement is shown at Fig. 1, where the aluminum wires *Al* (about 3 cm. in length) are fused into the thick glass envelope *Gl*. The glass envelope carrying the wires is shown sealed into the lamp in Fig. 2, which needs no further explanation.

The joint between the glass and the aluminum is made tight during the exhaustion of the lamp in the following manner. It is a well known fact that aluminum when amalgamated by contact with a solution containing mercury, oxidizes rapidly, becoming covered with the oxide alumina, in the form of a dense powder. This incrustation of oxide, if caused to occur between the aluminum wires and the glass into which they are sealed, is said to make an air-tight joint. These properties are given effect to by applying a drop of a strong solution of mercuric chloride to the outer ends of the wires during the exhaustion of the lamp. The liquid is sucked in between the wires and the glass, and causes the amalgamation of the surface of the metal and its consequent oxidation, the oxide being tightly enclosed and forming an air-tight lute. As soon as the joint is tight the ingress of air is, of course, prevented, and oxidation ceases. Should a small leak occur it cures itself by the action of the oxygen on the remaining aluminum amalgam resulting in the production of a further supply of luting material (alumina) precisely at the point where it is needed. The aspect of the wires with their coating of alumina *o o* is shown in Fig. 3.

PERSONAL.

PROF. GEORGE FORBES, F.R.S., left for England last week, bringing to a close the work which during the past two or three years he has been engaged upon as consulting electrical engineer to the Cataract Construction Co. As a matter of fact, that Company will pass with the close of the year from the constructive to the commercial stage of its existence, and will enter upon the active work of manufacturing and selling power with its main

apparatus built, tested and standardized. During this anxious and critical time, Prof. Forbes has, of course, been in most intimate relations with the managers of the great enterprise, and now closes his professional engagement, under terms of entire friendliness and cordiality on both sides. The advice and opinion of Prof. Forbes have been eagerly sought in regard to other plans of electrical power transmission, and we are glad to know that the revival of trade and industry, long-looked-for and not now far distant, may necessitate his further and early visits to this country. We should not be surprised to learn that as the result of observation or experience here, Prof. Forbes may, *ad interim*, see his way to the encouragement of smaller power transmissions in England, where there are no Niagaras but many available waterfalls, to say nothing of coal mines near large cities.

PROF. S. H. SHORT favored the Electric Club of Cleveland recently with a most interesting extemporaneous address on "Armature Winding," in which after glancing at the history of the subject he proceeded to discuss the practical issues and explained the differences between drum, ring, smooth, toothed and other types of winding.

LETTERS TO THE EDITOR.

ARMATURE-DISC CUTTING.

It is an old adage that "a man is not to blame for what he doesn't know." This, however, is not infallible, as we are often reminded that we ought to have known better. It is seldom, however, that a man is taken to task for what he does not say. It is what he does say that usually gets him into trouble. However, turn about is fair play, and Mr. Oberlin Smith thinks I ought to have said more about armature disc cutting in Paper I, of my series on Electrical Machinist Practice, and kindly completes the discussion in THE ELECTRICAL ENGINEER of Dec. 5, thus objecting to what I did not say. I will return the compliment by taking him to task for what he did say in the issue noted above.

Mr. Smith is at the head of a large manufacturing concern which makes a good deal of machinery designed for working sheet metal. He is in position to know whereof he speaks. He says that it does not pay to mill armature slots, or to punch them by the step-by-step method, that method being "out of the question for extended actual use." I have only this to say: If Mr. Smith will kindly visit me here in New York, we will go to motor shops where they mill all their armatures, also to another shop where they punch all the discs by a step-by-step method of indexing. We will also listen to the statements of shop owners who have got tired of paying for nice dies for punching discs at one operation, and having the dies last only 4 or 5 weeks before breaking; something which they were unfortunately always sure to do.

JAMES F. HOBART.

BROOKLYN, N. Y.

MULTIPOLAR ARMATURE WINDINGS.

DURING the discussion of Mr. Dunn's recent lecture before the New York Electrical Society at Columbia College on "Direct Current Motor and Dynamo Design" I understood Mr. Tesla in a very neat speech in praise of the lecturer, to mention as a matter of little consequence in view of his praises, that all of the devices, windings, etc., described were very old, and that the windings especially were attributable to Weston. I was considerably surprised at this although Weston is entitled to more credit than he usually receives for being the originator of much that is good.

Among other things, Mr. Dunn explained what is known as the four pole, two brush or two-circuit winding for drum armatures and its mate for ring armatures, and in view of the fact that the Crocker-Wheeler Electric Company have spent much time and a great deal of money investigating the merits and true ownership of these windings and securing the rights to them from abroad, I was surprised to hear them attributed to Weston, especially as I was not aware that he had ever done much in multipolar construction.

I was immensely pleased with the spontaneous outbursts of praise from a number of prominent gentlemen, amounting almost to an ovation. I can justly add that the conscientious ability of the lecturer has contributed very materially to the success of our Company.

SCHUYLER S. WHEELER,

President, Crocker-Wheeler Electric Co.

NEW YORK, Dec. 10, 1894.

EARLY MORNING TEST IN TELEPHONE OFFICES.

In your issue of the 12th inst. I notice a letter criticising my article on the "Early Morning Test in Telephone Offices." It is evident that the writer, Mr. Robt. C. Matlock, cannot have read

the article very carefully. His letter implies that I advocated the abandonment of the regular morning test by the operators, and the substitution of a "mechanical" method incapable of telling anything about the condition of the instruments in subscribers' offices.

I regret the necessity of pointing out that my language in this regard was perfectly clear, and could not bear such construction. In the first sentence I referred to the regular morning test as one that "well repays the trouble taken," and a moment later as "indispensable." I fail to comprehend how anyone could have misunderstood statements so simple. Yet that is what Mr. Matlock has done, and his subsequent description of the good features of personal testing is quite superfluous, as no one has ever called them in question.

The objection which I made to the regular test was that it is not complete till the majority of the subscribers are at their places of business. The mere fact that local conditions may make the business day begin at an early hour, is nothing to the point.

In making the assertion that business telephones can be tested by 7.45 in the morning, he betrays his want of familiarity with the conditions prevailing in large cities, where few offices are open till long after that time.

Admitting that the operators' test sheets are in the hands of the Chief at 8 o'clock, and presuming that the day force reports for duty at 7, it follows that one hour is spent in making tests. Unless troublemen are sent out on the mere word of the operators, the chief must make further tests on the lines reported, before distributing the work. All this means delay, and to say that troublemen have found "something" to do in the interval does not dispose of the fact that subscribers' lines were out of service while the men were otherwise employed.

JAS. W. MANSON.

NEW YORK, Dec. 14, 1894.

LITERATURE.

Electric Railway Motors: Their Construction, Operation and Maintenance. By Nelson W. Perry, E. M. New York: Street Railway Gazette Co. 1894. Cloth, 12mo. 256 pages. Illus. Price, \$1.

This is a most commendable attempt to enlighten and instruct a large body of men, to whom, without much or any previous training on their part, has been committed the care of millions of dollars worth of apparatus. It is a book which we would strongly advise every electric railway company to buy several copies of and to place them in the hands of the men employed on the road, for study and reference. Many of the men will doubtless purchase the book for themselves, but it will be money in any company's pocket to have its operating staff read, mark and inwardly digest the contents of such a lucid and pithy little volume. Mr. Perry's literary ability, of which he has plenty, does not lie along the line of brevity and epigram, but in this instance his readiness to enlarge on the subject has the advantage of making what he says so plain and clear that the reader of humblest intelligence has no excuse for not grasping the point of the argument. Although the treatment is diffuse, it is in no sense labored, but bright and interesting, and should prove attractive. Mr. Perry starts out with the assumption that the motorman knows nothing, and he proceeds to develop each branch of the subject in a very helpful manner; so that we have a well-rounded treatment of the laws of the current, the motor, the dynamo, regulation, and such specific details as trolleys, conduits, storage batteries, brakes, gears, etc. Moreover there are chapters on management, and lots of excellent pointers for superintendents, inspectors, motormen and others.

In short, Mr. Perry has written a book that in itself should give him the reputation of a skillful expositor, if indeed he had not already secured it; and we would heartily recommend it to engineering and general readers altogether outside the class for which it is primarily intended. It is got up in neat handy form, and will, we trust, enjoy a very large sale.

MARRIED.

INSULL—VAN VLIET.

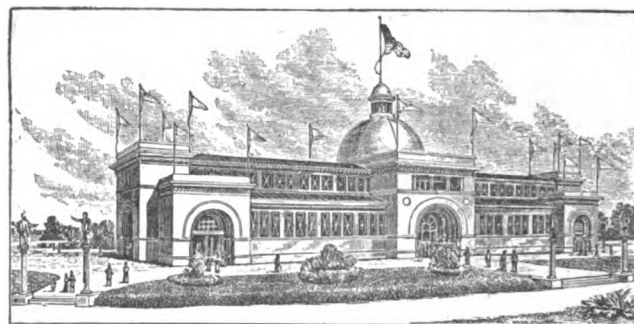
Mr. Martin John Insull, of the well known engineering firm of Sargent & Lundy, of Chicago, was married on Dec. 13 at East Orange, N. J., to Virginia, daughter of Mr. John Reed Van Vliet. The best man was Mr. George Greene, and among other electrical people present were Mr. and Mrs. W. E. Gilmore, of the Edison Laboratory, Messrs. C. Batchelor, W. S. Perry and T. C. Martin. The happy pair will take up their residence, after the honeymoon, at the beautiful suburb of Evanston, Ill.

COTTON STATES AND INTERNATIONAL EXPOSITION.

The Cotton States and International Exposition which will be held in Atlanta, Ga., from September 18th to December 31st, 1895, promises to be a turning point in the history of the Southern States. It has received the indorsement of the United States Government, Congress having appropriated \$200,000 for a Government building and exhibit. The Exposition has also received the indorsement of the Legislatures and principal commercial bodies of all of the Southern States, and reasonable assurance has been given that many of them will be represented by State buildings and exhibits.

Several European governments are expected to be represented and two exhibits from Africa are already assured.

Piedmont Park has been selected as the site for the Exposition. More than \$300,000 has already been expended in heightening the varied and interesting landscape, and \$150,000 more will be expended by the management of the Exposition in further projected improvements, which will make the already beautiful grounds an artistic triumph of landscape architecture. Great inland lakes twenty acres in area have been constructed, and with few exceptions all the buildings will have water frontage. On these lakes electric launches and gondolas will ply, affording



PROPOSED ELECTRICITY BUILDING AT THE COTTON STATES AND INTERNATIONAL EXPOSITION.

an agreeable mode of transit from one part of the extensive grounds to another.

The buildings, with the ground space they will occupy, are as follows:

United States Government.....	180x260 ft.
Manufactures and Liberal Arts.....	216x370 ft.
Machinery.....	100x500 ft.
Minerals and Forestry.....	80x220 ft.
Agriculture.....	150x800 ft.
Electricity.....	91x250 ft.
Transportation (nearly completed).....	126x418 ft.
Woman's Building.....	110x220 ft.
Fine Arts Building.....	100x245 ft.
Negro Building.....	100x300 ft.

A view of the proposed Electricity Building is shown in the accompanying illustration.

While it is not proposed to imitate the magnificent World's Fair structures, it is intended to provide imposing and substantial buildings which will be creditable to the Exposition and suited to the requirements of exhibitors and the public.

Excellent rapid transit facilities and hotel accommodations will be provided, and no pains will be spared to make the Exposition successful in every respect.

SOCIETY AND CLUB NOTES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The 92nd meeting of the Institute, will be held at 19 West 31st Street, on Wednesday, December 19, at 8 P. M. A paper will be presented by Mr. Ludwig Gutmann, of Chicago, entitled, "On the Production of Rotary Magnetic Fields by a Single Alternating Current." In the absence of the author, the paper will be presented in abstract by Dr. M. I. Pupin. A meeting of Western members will be held the same evening, Wednesday, December 19, 8 P. M., at Armour Institute, 33rd Street and Armour Avenue, Chicago, where the paper will be read by the author.

ELECTROZONE BEFORE THE BROOKLYN INSTITUTE ELECTRICAL SECTION.

Mr. A. E. Woolf delivered a lecture before the Institute of Arts and Sciences of Brooklyn, December 7th, which caused more or less spirited discussion among some of the doctors who were present. Mr. Woolf in the course of his address claimed that bi-chloride of mercury, carbolic acid and sulphurous acid

which are the principal disinfectants used by the medical profession, were not true disinfectants, particularly in cases of spore germs. A committee of doctors was appointed to investigate the statement and report at a future meeting. The lecturer also discussed a paper which had been read before a scientific society in Boston on the general subject of disinfectants showing the inaccuracy of the statements contained there.

The lecture was listened to by a large audience with great interest. At its termination a vote of thanks was unanimously tendered to Mr. Woolf by the Society.

N. E. L. A. COMMITTEE OF ARRANGEMENTS AT CLEVELAND.

Mr. Chas. W. Wason, who accepted recently the post of chairman of the local committee of arrangements for the entertainment of the National Electric Light Association, next February, is already applying himself with wonted energy to the work. Mr. Wason is also president of the Electric Club of Cleveland, and can count on its active support. He has now appointed the following well-known gentlemen as members of the Arrangement Committee. They represent all the varied electrical interests of Cleveland: Myron T. Herrick, W. H. Lawrence, Horace E. Andrews, E. P. Roberts, Frank De H. Robinson, Chas. F. Brush, Robert Lindsay, W. B. Cleveland, Elmer A. Sperry, C. Corlett, J. P. McKinstry, Hon. M. A. Hanna, S. M. Hamill, C. H. Rockwell, J. Potter, Frank Billings, N. S. Possons, E. L. Babcock, Samuel Scovil, S. H. Short, A. V. Kurtz, Geo. M. Hoag, C. S. D. Johns.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED DECEMBER 11, 1894.

Accumulators:—

Process of Manufacturing Plates for Secondary Batteries. H. F. Kirkpatrick-Picard and H. Thame, London, Eng., 530,847. Filed Jan. 13, 1894.
The process is based upon the fact that an oxide of lead can be reduced to metallic lead by the admixture of a reducing agent with a simultaneous formation of a gas.

Alarms and Signals:—

Fire Alarm and Annunciator System. F. S. Palmer, Boston, Mass., 530,648. Filed March 24, 1894.

An electric system for sounding an alarm either in case of fire or as a hotel annunciator.

Electrical Block Signal Apparatus. U. J. Fry, Milwaukee, Wis., and G. M. Basford, Oak Park, Ill., 530,762. Filed July 5, 1893.

Block Signal Apparatus. U. J. Fry, Milwaukee, Wis., and G. M. Basford, Oak Park, Ill., 530,763. Filed Sept. 17, 1894.

Railway Signal. J. V. Richardson, Farmville, Va., 530,798. Filed March 30, 1894.

An automatically operated electric block system.

Fire Alarm Hut. H. Trudel, Montreal, Can., 530,808. Filed Sept. 17, 1894.

A cell provided with mechanism which keeps the door closed against the person therein ringing the alarm until somebody possessing a proper key releases the locking device and opens the door to ascertain from said person where the fire is located.

Automatic Fire Alarm. W. A. Guthrie, Durham, N. C., 530,839. Filed Apr. 26, 1894.

Conductors, Conduits, and Insulators:—

Insulator for Electric Overhead Construction. H. P. Ball, Bridgeport, Conn., 530,498. Filed June 28, 1894.

A globe strain insulator with two eye bolts.

Insulator. L. McCarthy, Boston, Mass., 530,706. Filed Sept. 18, 1894.

Distribution:—

Alternating Current Transformer. A. W. Weston, St. Louis, Mo., 530,597. Filed Jan. 23, 1893.

Provides means whereby the same transformer may be used on circuits over which are being transmitted respectively currents of different voltages.

System of Transmitting and Distributing Electrical Energy. C. C. Chesney, Pittsfield, Mass., 530,748. Filed Apr. 19, 1894.

The method consists in generating three phased currents of low frequency and high tension, operating by these a motor, and driving by such motor a two phase generator adapted to yield currents of high frequency, and distributing such currents to translating devices.

Dynamos and Motors:—

Brush for Dynamo Electric Machines. E. T. Platt, Chicago, Ill., 530,717. Filed June 11, 1894.

Consists of a flexible body and a series of rolls arranged on an arc of a circle to make contact with at least two commutator segments.

Electric Motor. F. E. Herdman, Winnetka, Ill., 530,773. Filed July 25, 1894.

Adapted especially to the switch arm controlling the admission of current to the armature of the motor.

Galvanic and Thermo-Electric Batteries:—

Primary Battery. G. H. Gardner, Boston, Mass., 530,764. Filed Mch. 12, 1894.

Employs a cell in which an annular metallic plate is embedded, adapted to form a metallic lining for that part of the bottom of the cell between the porous cup and the walls.

Primary Battery. W. Walker, Jr., Birmingham, & F. R. Wilkens, Hantsworth, Eng., 530,587. Filed June 4, 1894.

Employs a negative electrode of carbon forming part of the jar with one surface of the carbon in contact with the exciting solution and the other exposed to the atmosphere.

Lamps and Appurtenances:—

Incandescent Lamp. J. R. Grove, New York, 530,898. Filed May 26, 1893.

Claim 1 follows:—

In an incandescent lamp, the combination with a bulb having its neck closed by an independent section of fusible material spanning the neck

opening, of a non-metallic yielding medium located on adjacent parts of glass and said section.

Arc-Light Hanger-Board. D. J. Cartwright, Boston, Mass., 530,882. Filed Jan. 26, 1894.

Incandescent Electric Lamp. E. Kaye, Monaca, Pa., 530,893. Filed Feb. 4, 1893.

Claim 2 follows:—

An incandescent electric lamp, having a threaded neck, in combination with a removable plug or stopple and a cap threaded interiorly to screw into a lamp socket.

Miscellaneous:—

Suppression of Self Inductive Obstruction in Electromagnetic Apparatus. S. D. Field, Stockbridge, Mass., 530,516. Filed July 24, 1894.

Employs a conductor in reciprocal inductive relation with the wires composing the helices for the purpose of suppressing the reactance of the magnet.

Galvanic Ring. D. Hattenback, Sioux City, Iowa, 530,522. Filed Sept. 4, 1894.

Claim:—

A metallic ring in two parts soldered together; the metal in each part differing from that in the other part forming in the completed ring positive and negative electrodes.

Apparatus for Controlling Electric Elevators. N. O. Lindstrom & O. P. Cummings, Brooklyn, N. Y., 530,541. Filed Sept. 20, 1894.

Employs a small motor whose direction of motion is controlled by a switch on the car to operate a circuit closing and reversing switch upon the main motor.

Electric Elevator Controller. L. S. Buffington, Minneapolis, Minn., & W. C. Jones, Chicago, Ill., 530,578. Filed Feb. 23, 1894.

Relates to means for automatically controlling the elevator car and doors.

Electric Motor Propelled Elevator. F. E. Herdman, Indianapolis, Ind., 530,619. Filed Jan. 31, 1893.

Provides means whereby if the elevator become overloaded the current in the field is increased, and in case of an excessive overload the current is entirely cut off.

Electric Cigar Lighter. C. J. Coleman, Chicago, Ill., 530,637. Filed Mch. 24, 1894.

Railways and Appliances:—

Controller for Electric Locomotives. J. W. Darley, Jr., Baltimore, Md., 530,507. Filed Nov. 16, 1893.

Employs an electromagnetic circuit breaker, a commutating cylinder and apparatus operated thereby to vary the capacity of the circuit breaker according to the division of the cylinder.

Conduit Electric Railway. D. Mason, Schenectady, N. Y., 530,543. Filed June 8, 1893.

Claim 1 follows:—

In an electric railway system a tubular or hollow trolley conductor in combination with means for heating and forcing liquids, vapors or gases through it.

Trolley Wire Clamp. M. M. Wood, Chicago, Ill., 530,569. Filed July 3, 1894.

Rail Bond or Connector. C. J. Reed, Philadelphia, Pa., 530,651. Filed Sept. 20, 1894.

Consists of two separate parts screw threaded into the ends of the rail, and then twisted together and united by solder.

Trolley Wire and Support Therefor. H. H. Ashley, Springfield, Mass., 530,674. Filed Aug. 25, 1894.

Provides for the automatic cutting-out of a section of trolley wire in case of a break.

Conduit Railway Trolley. J. C. Hawley & W. J. Black, Duncannon, Pa., 530,688. Filed Mch. 23, 1894.

Employs a reversible trolley-carrying bracket carrying a contact wheel at its outer end.

Conduit Railway Trolley. W. E. Delabarre, F. M. Frazer & B. A. Carrick, New York, 530,688. Filed Jan. 26, 1894.

Provides means whereby a slot through which the connection is made will be so located as to serve also as a channel for the flange of the wheel.

Switches and Out-Outs:—

Rheostat. T. W. Shelton, St. Louis, Mo., 530,727. Filed Aug. 20, 1894.

Employs discs of fire clay bolted together and having embedded between them convolute conductors.

Battery Switch. H. K. Spangenberg, Leipzig, Germany, 530,804. Filed July 24, 1893.

A distributing board provided with means for cutting out one set of cells and for coupling the two sets in series or multiple.

Telephones and Apparatus:—

Telephone Transmitter. A. F. Boardman, Somerville, Mass., 530,575. Filed Aug. 6, 1894.

Employs a molded support comprising an annular ring and an offset, a recess in the ring under the offset, a diaphragm supported on the ring and electrodes mounted on the offset.

Telephone System. W. Oesterreich, Berlin, Germany, 530,598. Filed Oct. 12, 1893.

Consists principally in the combination with a multiple switchboard of a battery connected with a circuit opposite to that of the telephone station in question by a circuit closer.

"SCIENCE."

The weekly journal *Science* will, we are glad to hear, be published after January 1st, under the direction of an editorial committee in which each of the sciences is represented by a man of science who is at the head of his department. The committee is constituted as follows: *Mathematics*, Prof. S. Newcomb (Johns Hopkins University and Washington); *Mechanics*, Prof. R. S. Woodward (Columbia College); *Physics*, Prof. T. C. Mendenhall (Worcester); *Astronomy*, Prof. E. C. Pickering (Harvard University); *Chemistry*, Prof. Ira Remsen (Johns Hopkins University); *Geology*, Prof. J. LeConte (University of California); *Physiography*, Prof. W. M. Davis (Harvard University); *Paleontology*, Prof. O. C. Marsh (Yale University); *Zoology*, Prof. W. K. Brooks (Johns Hopkins University); Dr. C. Hart Merriam (Washington); *Botany*, Prof. N. L. Britton (Columbia College); *Physiology*, Prof. H. P. Bowditch (Harvard University); *Hygiene*, Dr. J. S. Billings (Washington); *Anthropology*, Prof. D. G. Brinton (University of Pennsylvania); Major J. W. Powell (Washington); *Psychology*, Prof. Cattell (Columbia College). This committee assures a high scientific standard and wide field of usefulness to the journal.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE COMMERCIAL ELECTRIC COMPANY'S MULTIPOLAR GENERATORS AND MOTORS.

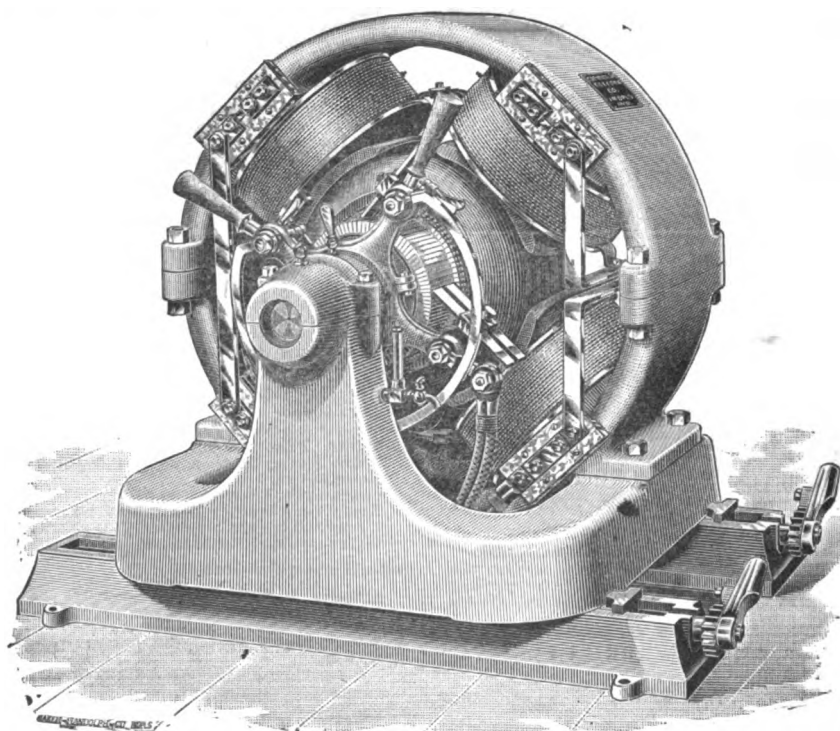
As improvement in the manufacture and construction of electrical apparatus is so keenly appreciated by purchasers, it is pertinent to call attention to the new slow speed, multipolar generators and motors which have recently been placed on the market by the Commercial Electric Company of Indianapolis, Ind. These machines, as will be seen from the accompanying illustration are exceedingly compact and neat in appearance, and their slow speed, the small floor space required, and their high efficiency, make them especially desirable machines for both lighting and power.

1. The armatures, which are of the smooth core, Gramme ring type, are made of a special grade of iron having an exceedingly small hysteresis loss, and the absence of teeth does away with eddy currents in the pole pieces and the sparking due to high self induction of the conductors. The armatures are thoroughly ventilated, and this, together with the large cross section of the

have been installed during the last few months, both for lighting and power work, and the Commercial Company are receiving the highest commendations on them.

WARREN WEBSTER & CO.

Messrs. Warren Webster & Co., of Camden, N. J., specialists in examining steam plants where increased economy in fuel is desired, by utilizing waste exhaust steam, report considerable activity in their business, owing to the better appreciation of their manufactures. Among the recent orders for the Webster "Vacuum" feed water heater and purifier they mention the following: Wheeling Steel & Iron Co., Wheeling, W. Va., 2,000 H. P.; Morrison & Cass Paper Co., Tyrone, Pa., 1500 H. P.; Harrisburg Rolling Mill Co., Harrisburg, Pa., 1250 H. P.; Chicago Dock & Canal Co., Chicago, Ill., 900 H. P.; Johnstown Electric Light Co., Johnstown, Pa., 800 H. P.; Laidlaw, Dunn, Gordon Co., Cincinnati, O., 600 H. P.; North Packing & Provision Co., Somerville, Mass., 500 H. P.; Warren Electric Light Co., Warren, Pa., 400 H. P.; Schoolkoph Analine Chemical Co., Buffalo, N. Y., 400 H. P.; Kaukauna Fibre Co., Oconto Falls, Wis., 300 H. P.; Plattville Electric Light Co., Plattville, Wis., 200 H. P.; Ackroyd & Scull, Camden, N. J., 200 H. P.; York Card & Paper Co., York, Pa., 200 H. P.; Jerseyville Electric Light, Gas & Power Co., Jerseyville, Ill., 350 H. P.; Lamb



COMMERCIAL ELECTRIC CO.'S DYNAMO AND MOTOR.

conductors and the freedom from core loss, obtained by the above construction, results in a very small rise in temperature. Each coil of the armature is entirely independent, and if damaged can be renewed without disturbing any of the others.

2. The commutator is made of the hardest copper and clear sheet mica insulation and the great useful depth of the segments admits of turning it down many times without renewal. The magnet frame is of cast steel of high permeability and it is mounted on a broad cast iron base, which carries the bearings. The latter are of the spherical, self-aligning type, and are provided with oiling rings which dip into an oil reservoir of large capacity. The bearings have phosphor bronze linings, and large bearing surfaces.

The pulleys are of large diameter and have ample belt surface so that the full power of the machine may be transmitted with but light pressure on the bearings due to belt pull. The field coils have a large radiating surface, and thus run at a very low temperature. They are easily removed and the series coils are placed at one end of the spool, so that either the series or shunt coil can be repaired without disturbing the other. The brush holders are mounted upon a rocker arm and have independent adjustment of position and tension. The insulation is of high grade and will, it is claimed, withstand a pressure of 5,000 volts between the windings and the frame.

These machines are built in sizes from 40 to 100 K. w. and are adapted for belt driving or direct connection. Their ability to withstand the sudden fluctuations of load and the severe temporary overloads peculiar to street railway work, make them especially valuable for that purpose. A large number of these machines

Mfg. Co., Chicopee Falls, Mass., 300 H. P.; Bridgeport Electric Light & Power Co., Bridgeport, O., 250 H. P.; Card Electric Co., Mansfield, O., 150 H. P.; E. A. Baggs, Conowango Valley, N. Y., 80 H. P.; The Cusmer Co., Norfolk, Va., 200 H. P.; Worcester Electric Light Co., Worcester, Mass., 150 H. P.; Smith Wilson & Seras Paper Co., Holyoke, Mass., 150 H. P.; Jersey City Milling Co., Jersey City, N. J., 300 H. P.; Longmead Iron Co., Conshohocken, Pa., 350 H. P.; Lake Erie Ice Co., Cleveland, O., 250 H. P.; The Falkenau Engineering Co., Philadelphia, Pa., 250 H. P.

Numerous orders were also received for the Webster separators and the Williams vacuum system of steam heating.

WESTERN UNION REVENUES.

Revenues of the Western Union Telegraph Company, partly estimated, for the quarter ending Dec. 31 have been reported to the Directors for their information in acting on the dividend.

The showing was good enough to justify the usual dividend of 1½ per cent. Net revenues were placed at \$1,600,000, an increase of \$106,906, compared with the last quarter of 1898. There will be applied to the interest and sinking fund account \$243,800, leaving the balance \$1,357,200, an increase of \$103,818. The dividend payment will be \$1,192,000, leaving a surplus of \$165,000, an increase of \$101,818. The surplus Oct. 1 was \$7,886,468, and the estimated surplus for Dec. 31 is \$7,551,668, an increase over last year of \$279,606.

FORD & SMITH.

Messrs. E. S. Ford and S. J. Smith have recently formed a copartnership, as contracting engineers, and have opened an office in the Wade Building, Cleveland, Ohio. They are prepared to install electric plants of from ten to two thousand lights, or motive power from one-eighth to one hundred and fifty kw. or larger if desired. Electric power transmission is one of their specialties, and they are also prepared to do any kind of electrical construction or repairs. Mr. E. S. Ford has had considerable experience in electricity, having been secretary of The Ford-Washburn Storelectro Company for three years, and consequently has an extended acquaintance, while Mr. S. J. Smith, aside from being an engineer, has for two years previous to the formation of the partnership, been secretary of The Brightman Stoker Company, in which capacity he has formed an extended acquaintance in both the electrical and mechanical fields. The new company, therefore, feel that they enjoy a prestige, which few concerns possess at the start, and confidently expect to uphold the high standard they have set for themselves.

ENLARGING THE GENERAL ELECTRIC WORKS AT SCHENECTADY.

THE increase in electrical business now being done by the General Electric Company has necessitated an increase of their already extensive facilities at Schenectady, and two large buildings are being constructed by Grattan & Jennings. One of these is a storehouse, 858 feet long and 52 feet wide. The foundations are already laid and the superstructure is rising rapidly. This will relieve the smaller storehouses now found entirely inadequate.

The other building will be used as a laboratory for standardizing. It will be erected on the very outskirts of the tract of land owned by the company at Schenectady, in order that it may be as far away as possible from the disturbing influences of moving iron and heavy electric currents in and around the many buildings of the plant proper. This laboratory will contain all the standard instruments of the company, and with these the working instruments, which are in use throughout the factories for testing purposes, will be compared each day.

NEW 800 KILOWATT GENERAL ELECTRIC ALTERNATOR FOR ST. LOUIS.

The General Electric Company is now building, at its Schenectady works, one of the largest alternating current generators ever constructed. The generator is to be installed at St. Louis, Mo., in the station of the Edison Electric Illuminating Company and will supply current for incandescent and arc lighting and for motor service.

In order to secure efficient results for these various uses, the generator is constructed on the "monocyclic" system, recently adopted by the General Electric Company.¹ This system em-

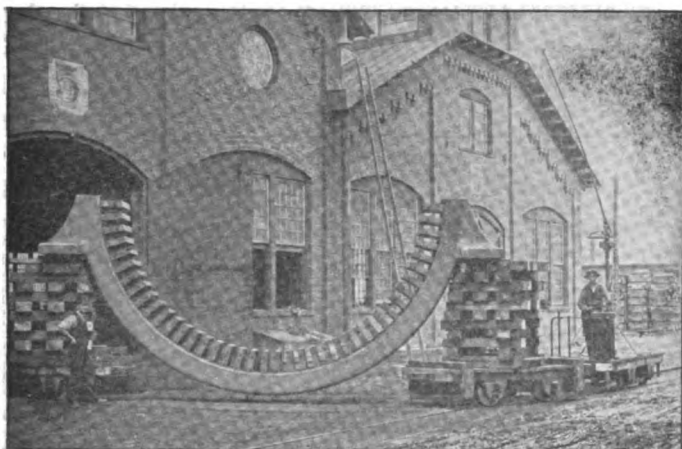


FIG. 1.—MAGNET FRAME, 800 KW. G. E. MONOCYCLIC ALTERNATOR.

plays a comparatively low frequency of alternation and the armatures of the generators have special windings adapting them for use on circuits with self starting alternate current motors. The generator, the lower magnet frame of which is illustrated in Fig. 1, is of 800 kilowatt capacity, has 80 poles and is to be driven by a Hamilton-Corliss engine at 90 revolutions per minute.

On account of the great size of the frame, difficulties were to

be expected in producing the castings, but thanks to the facilities of the Schenectady Works no trouble was experienced in pouring even the large frame casting shown. This single piece, made up in part of wrought iron embedded in the casting, weighs 35 tons and measures 24 feet over all. The armature is iron clad and is 16 feet in diameter, weighing nearly 100,000 pounds. The armature will be supported on a 22-inch shaft.

The illustration Fig. 2 shows also the armature spider before

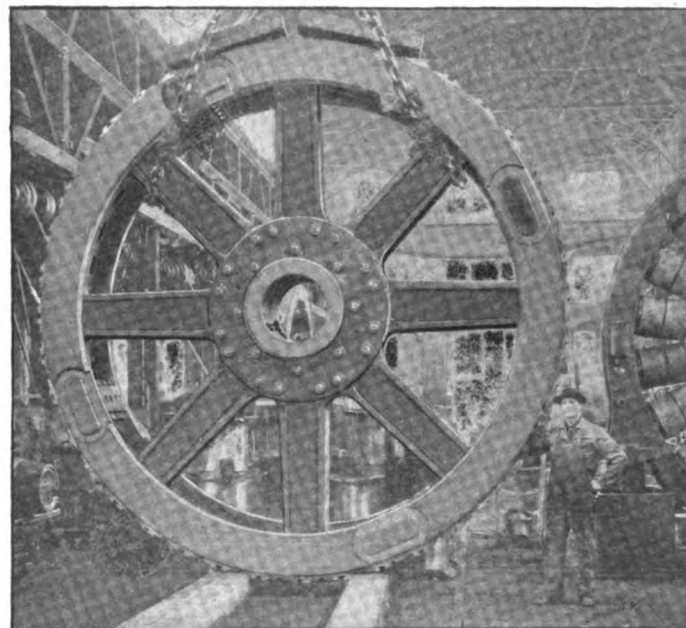


FIG. 2.—ARMATURE SPIDER, 800 KW. G. E. MONOCYCLIC ALTERNATOR.

the laminations were placed upon it. An idea of its size may be had by comparing the spider with the 400 kilowatt rotary converter which stands to the right of it.

The completed generator will supply at full load 667 amperes at 1200 volts, equivalent to 16,000-18 c. p. lamps. In this connection it should be stated that the great size of the generator was necessitated by the requirements under which the machine is to be operated, chief of which is the low speed of revolution.

SALES OF LA ROCHE APPARATUS.

MR. F. A. LA ROCHE, President & General Manager of the La Roche Electric Works reports the following sales of their well-known apparatus:—

Wernersville Insane Asylum, South Mountain, Pa., three 1000 light, bi-polar dynamos; Burtis & Howard, Minneapolis, Minn., one 800 light alternator; Jefferson Ice Co., Philadelphia, one 200 light dynamo; Lorraine Apartment House, Philadelphia, two 1200 light and one 600 light dynamo; Atchison Light & Power Co., Atchison, Kan., one 800 light and one 1500 light alternator; McCurdy Bros., Philadelphia, one 80 k. w. direct current dynamo; Dedham Court House, Dedham, Mass., one 20 k. w. alternating dynamo; Hammond Light & Power Co., Hammond, Ind., one 3000 light, two phase alternating current dynamo and accessories, duplicate order; Berkeley Electric Light & Power Co., Berkeley, Cal., one 1500 light alternator, duplicate order; Atchison Light & Power Co., Atchison, Kan., transformer capacity for 5000 lights; Wm. Hood, Chicago, Ill., one 3000 light alternator, one 500 light alternator and one 1500 light alternator.

The management state that they are running with a full force of men and in order to make prompt deliveries, are compelled to run the works several evenings each week. The company certainly deserve credit for the able way in which they are handling large contracts. They have been awarded some of the largest recent Government contracts which were finished in a highly creditable manner. The business is managed in a most conservative way and this has enabled them to make rapid strides so that they stand to-day as one of the most successful manufacturing companies in the country.

ST. LOUIS IRON & MACHINE WORKS.

The St. Louis Iron & Machine Works have recently closed a contract with the Bloomington Electric Light Co. Bloomington, Ill., for one of their 850 H. P. "St. Louis Corliss" engines, to replace four high speed engines.

1. See THE ELECTRICAL ENGINEER, Sept. 26, 1894.

BIDDING ON PLANT FOR THE DAYTON, O., HOSPITAL.

Bids have been opened at the Dayton, Ohio, Hospital for an electric plant. The following is a list of the bidders:

Dayton Electric Co., Dayton, Ohio, engine, \$2,453.78; electric plant, \$10,027.05; entire plant, \$12,470; \$12,904.51; \$13,827.78; \$11,504.51. Western Electric Co., Chicago, Ill., engine, \$1,650; electric plant, \$7,809.52; engine, \$1,550; electric plant, \$7,124.52; entire plant, \$9,400; engine, \$2,800; \$1,525; \$1,490; \$1,875; \$2,200. Russell & Co., Massillon, Ohio, engine, \$2,200; \$1,900; \$8,000. I. & E. Greenwald Co., Cincinnati, Ohio, engine, \$3,100. Bissell & Dodge, Toledo, Ohio, electric plant, \$10,674; \$10,881.80. McKee Bros., State College, Pa., entire plant, \$11,690. Card E. M. & Dynamo Co., Cincinnati, Ohio, electric plant, \$9,529.20; entire plant, \$14,059.20. Lane & Bodley Co., Cincinnati, Ohio, engine, \$2,429. J. N. Rugg & Co., Cincinnati, Ohio, engine, \$1,800. Fort Wayne Elec. Corp., Fort Wayne Ind., entire plant, \$8,490; \$7,735. A. S. Schulman, Cincinnati, Ohio, engine, \$1,950; electric plant, \$9,000; entire plant, \$10,900; electric plant, \$8,900; engine, \$2,400; electric plant, \$7,800; \$8,800; entire plant, \$10,700; engine, \$3,400; electric plant, \$8,800; entire plant, \$11,700; electric plant, \$8,050. New York Safety Power Co., Chicago, Ill., engine, \$2,100.

NEW YORK EDISON EARNINGS.

Subjoined is a comparative statement of November earnings of the Edison Electric Illuminating Co. of New York.

	1894.	1893.	
Gross.....	\$145,904.00	\$121,701.54	\$24,202.46
Net.....	82,290.42	65,585.84	16,704.58
Eleven Months.			
Gross.....	\$1,286,016.57	\$1,078,869.87	\$157,647.20
Net.....	645,782.40	506,710.29	189,072.11

IMPORTANT CONTRACT SECURED BY THE STANDARD ELECTRIC CO.

We learn that the city of Springfield, Ill., has just awarded to the Standard Electric Co. of Chicago, a contract for five 80 light arc dynamos and two 80 k. w. alternators, including a complete electrical equipment. The competition for such orders in these times is unusually sharp and severe, and the tests applied are most rigorous, so that the Standard Co. is entitled to special congratulations upon securing such a victory. The apparatus is to be of the highest order, and the Standard Co. proposes to make the plant one of the finest in the country.

THE STORAGE BATTERY CONSOLIDATION.

THE consolidation of storage battery interests foreshadowed in the announcement made by us in a recent issue has now been consummated. This has been brought about by the efforts of the Electric Storage Battery Co., which has acquired all the patents and patent rights concerning the manufacture of storage batteries, of the General Electric Co., the Edison Electric Light Co., the Thomson-Houston Electric Co., the Brush Electric Co., The Accumulator Co., the Consolidated Electric Storage Co., and the General Electric Launch Co.

By this move the Electric Storage Battery Co. secures to itself the sole right to supply in the United States storage batteries of all the various important types heretofore developed. The acquisition of these patents naturally terminates all litigation now pending and leaves the Company free to prosecute its work to the best advantage. The Company has also increased largely its cash working capital and is fully prepared to fill all orders promptly.

NEW YORK NOTES.

MR. J. A. MACHADO, sole selling agent of Waddell-Entz dynamos and motors, has been awarded the contract for the light and power plant for the new building of the New York Clearing House. Direct connected generators will be used.

THE MATHER ELECTRIC COMPANY of Manchester, Conn., have just been awarded, through their New York contractors, Messrs. H. B. Coho & Company, the contract for three 100 k. w. direct connected generators of their new type, for the lighting plant of the new Congressional Library Building at Washington, D. C. Very extensive tests of this new apparatus were made by government experts at the Manchester factory, and the adoption of this apparatus by the United States Government reflects great credit on The Mather Electric Company.

THE GEO. L. COLGATE CO., of 136 Liberty street, have issued a neat little illustrated pamphlet as to their Climax iron clad rheostats, giving full details of construction, size, capacity, price, etc.; also their Climax theatre dimmers, lamp dimmers, field regulators,

etc. The company issue also a circular as to their McIntosh pole paints, which they guarantee for excellence, durability and cheapness. The paint is put up in barrels and in gallon cans.

THE AMERICAN ELECTRIC SUPPLY CO., of Buffalo, N. Y., have severed their agency relations with the Interior Conduit & Insulation Co. of New York. The American Electric Supply Co. are one of the oldest agents of the Conduit Co. and the relations between the two companies have always been of the pleasantest character. The Conduit company however have found that their interests are antagonized when represented by a construction house and have consequently changed their policy and in the future will be represented by supply houses not engaged or financially interested in the construction business. The American Electric Supply Co. could not afford to give up the large construction business they enjoy, and hence followed the friendly termination of their agency relations with the Interior Conduit & Insulation Co.

WESTERN NOTES.

CAPT. WILLARD L. CANDEE, of Okonite and Candee fame, paid Chicago a flying visit last week.

THE BRYANT ELECTRIC CO., through their office at 1522 Monadnock Block, Chicago, Ill., have taken the Western agency for the product of R. Thomas & Sons, manufacturers of porcelain.

MR. M. E. BAIRD of the Eddy Electric Mfg. Company spent several days last week at the office of Kohler Bros., their Western representatives.

THE LATE FRED. DEGENHARDT.—A number of the more intimate friends of the late Fred. E. Degenhardt held a memorial meeting at the Union League Club, Chicago, on Sunday the 16th inst., when his many manly virtues were recognized and extolled.

MR. P. J. MCQUADE of the National Conduit Manufacturing Co., New York, was among the many eastern visitors attending the funeral of the late Fred. E. Degenhardt.

MR. C. A. BROWN, Secretary of the Central Electric Co., is still confined to his home by a severe attack of malarial fever. While his sickness will by no means result seriously, the persistency with which the malady clings to him is not only regretted by his friends, but must be extremely aggravating to a man of Mr. Brown's energy and activity.

THE GRIER BROTHERS, Managers of the Western offices of the Bryant Electric Co., have found it necessary to considerably increase their storerooms and have just moved them to 1732-1733 Monadnock, where a complete line of Bryant specialties and R. Thomas & Sons Co.'s porcelain will be kept in stock. The office remains at 1532 Monadnock.

ANN ARBOR, MICH.—W. J. Miller, city clerk, has opened bids for lighting the city of Ann Arbor, Mich., with 91 arc lights of 2,000 candle power, for one year. The following was the only bid received: Ann Arbor Thomson-Houston Electric Co., \$78 for arc light and \$36 for 65 candle power lamp on moonlight schedule from sundown to 12:30 o'clock.

THE ELECTRIC APPLIANCE COMPANY are beginning their fourth business year by making some special inducements in price on their celebrated Packard transformer, which has made a great reputation for itself during the last few years for regulation and efficiency. The Electric Appliance Company make a point on carrying a very large and complete transformer stock in Chicago, enabling them to make immediate shipment from that point, and thus save customers long delays in transit.

THE CENTRAL ELECTRIC COMPANY under the active and judicious management of Mr. D. E. Goe have recently made several important changes in the arrangement of their offices and salesrooms, which cannot fail to make a favorable impression upon customers and visitors. The several departments have been arranged in a more systematic manner, sample tables with their endless variety of new and seasonable goods have been given the most favorable, get-at-able position and an air of order and originality pervades the entire establishment, which, to say the least, is refreshing.

THE LANCASTER RAILWAY CONSTRUCTION CO. has secured the contracts for building the extensions of the Reading Traction Co.'s system at Reading, Pa. The first line will be some fifteen miles in length and work will be commenced at once. Everything will be up to the highest standard and the Medbery line material will be used on the overhead line work. All material will be furnished by the Hubley Manufacturing Co.

Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE Electrical Engineer.

Vol. XVIII.

DECEMBER 26, 1894.

No. 347.

RECENT ELECTRIC PLOWING EXPERIMENTS IN GERMANY.

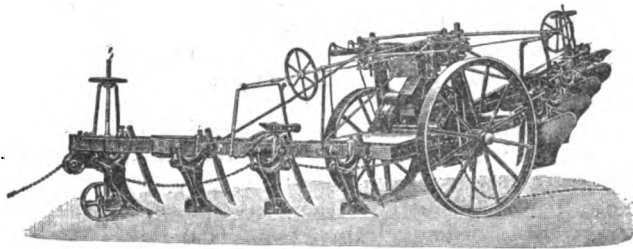


FIG. 1.—FOUR-SHARE ELECTRIC PLOW.

THE earliest attempts at electric plowing date back to the very first applications of the modern electric motor and consisted in a very close copy of the old two-machine steam plow, the only difference being that the electric motor replaced the steam engine for driving the rope gearing. After a close study of all the conditions involved, the firm of F. Zimmerman & Company, at Halle (Saale) Germany, manufacturers of agricultural implements, have brought out an entirely new construction of plow with which such excellent results have been obtained that we have deemed it worthy of more extended notice, owing to the importance of the subject.

The new plow, which is illustrated in the accompanying engraving, Fig. 1, is not pulled over the ground at the end of a wire rope, but the electric motor is mounted on the tipping plow and is carried with the plow as the latter is drawn over the field. The armature of the motor, through the medium of a chain and sprocket wheel, drives the shaft, over which passes a chain stretched along the length of the field. Both ends of this chain are fastened down securely by triple anchors. When the motor is set in operation it winds the plow over the field on the stationary chain. At the end of the field the plow is tipped and by a simple

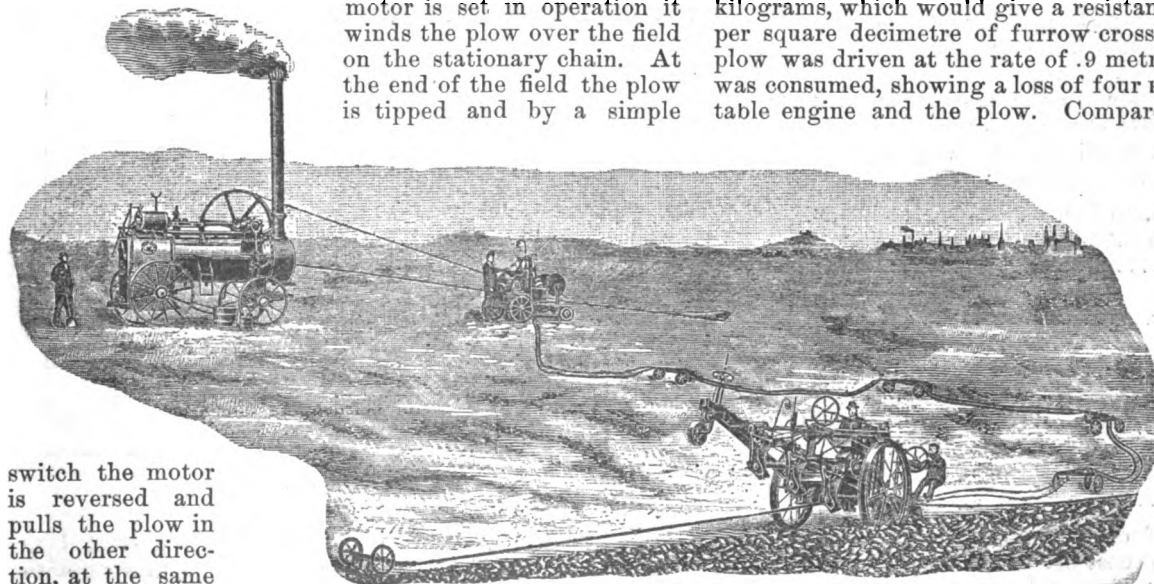


FIG. 2.—RECENT ELECTRIC PLOWING EXPERIMENTS IN GERMANY,

switch the motor is reversed and pulls the plow in the other direction, at the same time laying the

chain sidewise for the next furrow to be plowed. The shifting of the anchors is done by means of a crowbar, which pulls the anchor out of the ground, and the anchors are mounted on wheels so that they can be easily moved.

No trouble, of course, is encountered in the operation of the plow as just described, but the drawback which has always stood in the way of the application of electricity to plowing has been the difficulty of conducting the current to the motor with the plow travelling over the field. The usual method of conducting current to a moving motor by means of trolleys in contact with a fixed conductor was evidently out of the question here.

The manner in which this important point has been provided for is exceedingly interesting, and is illustrated in Fig. 2. Since the plow passes to and fro for a comparatively short distance, it may be considered as the end of a pendulum bob, which is connected to the centre of oscillation by the connecting cable; so that the latter, vibrating over the field, follows the movement of the plow. In order to avoid the friction and wear on the cable as it passes over the ground, the cables are mounted on light rollers and held by clamps, the rollers following readily the direction of motion of the plow.

Up to the present time the company has built two plows, one with two shares and one with four, both of which were put in operation in the neighborhood of Halle early this fall. The results were most encouraging, from the standpoint both of the quality of the work and the power consumed. The two-share plow was driven by a current obtained from a dynamo driven by a 10 H. P. portable engine. The earth was a heavy, binding clay. The dynamo showed 110 volts, and 80 to 80 amperes on an average, or 8000 watts, which would be equivalent to about 12 H. P. delivered by the engine. The plow made two furrows, having a combined width of 60 centimetres and a depth of 24 centimetres. The spring dynamometer showed a pull of between 600 and 700 kilograms and an average of 650 kilograms, which would give a resistance of 49.2 kilograms per square decimetre of furrow cross section. When the plow was driven at the rate of .9 metre per second, 8 H. P. was consumed, showing a loss of four H. P. between the portable engine and the plow. Compared with the indirect steam plows this was a very small loss.

To drive the large plow a 16 H. P., nominal, portable engine was used, three shares of the plow going to a depth of 24 centimetres. The anchors fastened themselves into the earth without any forward movement whatever and held absolutely fast. The pulling

up of the anchors and their transference in the case of the small plow was very easy, as the anchors weighed only 35 kilograms and even in the case of the large plow the weight did not exceed that which one man could handle. The roller skids upon which the movable cable was fastened followed the movement of the plow with great precision. With a length of field equal to 200 meters, the cable scraped along the earth in short stretches, but by the subsequent insertion of two additional rollers this scraping was entirely obviated. The dynamo and cable wagon is shown in Fig. 3.

The portable engines of 8 and 12 H. P., now largely used in agricultural work, are sufficient to drive a two-share plow in light earth, and also a three-share plow, depending

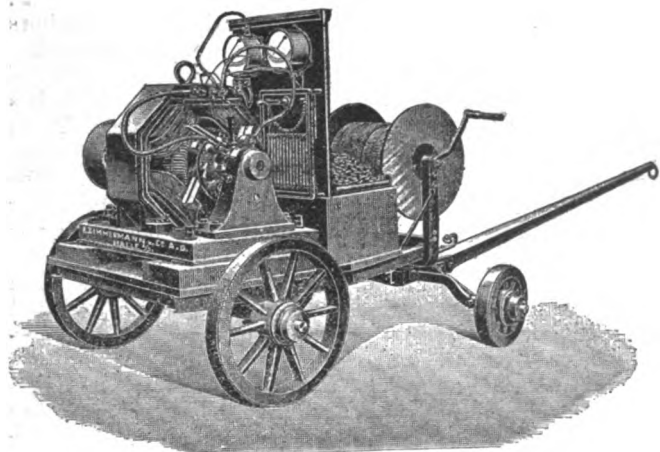


FIG. 3.—THE DYNAMO AND CABLE WAGON.

upon the nature of the ground and the depth of furrows. From two to four hectares¹ can be plowed in ten hours. As to the cost of electric plowing, the *Elektrotechnisches Echo*, from which we gather the above details, gives the following estimate:—

A 4-share tipping plow, with electric motor, cables, cable wagon, complete, ready for work, 10,000 marks; a 3-share plow, 8,000 M.; a 2-share plow, 6,000 M. Dynamo and conductors for 4-share plow, 5,500 M.; 3-share plow 4,000 M.; 2-share plow, 2,000 M.

As regards the cost of operation, we may cite a paper, read by Mr. Rimpau-Schlanstedt before the German Agricultural Society, in which he shows the cost of steam plowing, to a depth of 35 centimeters, to be 39.36 M. per hectare, and Mr. von Schnehen-Springer gives 46.72 M.; the latter figure, however, does not give the net cost because the apparatus was loaned for the occasion. The cost of plowing by means of oxen was unanimously given as 50 M. per hectare.

The cost of operation in the above named tests at Halle with the two-share plow and a portable engine, gave the following results, in which, however, depreciation of the portable engine is not included:

Wages of 1 fireman, 10 hours.....	3.50 M.
“ “ 2 men, at 2.50 M.....	5.00 “
“ “ 1 boy	1.50 “
	10 M.
Coal, 400 kilograms.....	9 “
Water hauling.....	5 “
Lubricant and dynamo brushes.....	3 “
Interest and depreciation on 8,000 M. @ 15% for 100 days,—per day.....	12 “
Repairs per day, estimated.....	2 “
Total.....	41 M.

With a capacity of only two hectares per day in the heavy soil at Halle, the cost per hectare was thus 20.5 M. or less than one half that of animal power.

1. One hectare equals 2½ acres; the mark equals about 25 cents.

AN ECONOMICAL SERIES STREET LIGHTING SWITCHBOARD.

BY

Arthur J. Farnsworth

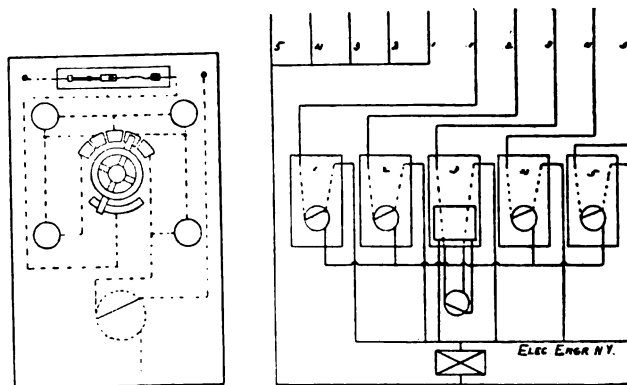
THE writer has recently had occasion to install a system of series street lighting, where it was desirable to incur as little expense as possible. The economy in my plan consisted in using only one ammeter with the several bank lines, instead of a separate instrument for each circuit, as is usually the case. I do not doubt that this idea has occurred to many, but for some reason it has not been generally adopted, and my experience may therefore not be out of place.

In the present case there were five circuits to be supplied. One regular bank board was ordered from the maker complete, and four boards complete, with the exception of the ammeters. On the latter in the usual place for the ammeters, were placed small, three-point, snap switches. The actual switch used was Crowell's "lazyman," but as the current is quite small, almost any three-way switch may be used which makes the change quickly enough. In operating such switches it is obvious that the circuit is open for a brief period, but this is not sufficient to cause the lamps to flicker in the least and is no objection to the arrangement. The only drawback to the system that I know of, is the slight amount of time that is necessary to throw the ammeter into the different circuits when first starting up, but when the number of lamps upon the different circuits has once been adjusted, the chances are that the circuits will require no further attention during the night.

As the ammeters usually supplied for this purpose are in no way dead beat, it is an annoyance to be obliged to wait for the needle to come to rest every time the instrument is changed from one circuit to another. To obviate this difficulty the needle may be blocked, so that it cannot return to zero, and can only swing in a small arc.

This system, which may evidently be applied to any number of bank lines, has given perfect satisfaction in every way since it has been in operation, and the saving in original cost has been about \$180 on the list price.

The figures show clearly the arrangement of circuits. Fig. 1 shows the internal connections of bank board and three-way switch, and Fig. 2 the arrangement of circuits



FIGS. 1 AND 2.

for five bank lines. The instrument is represented as being on circuit No. 3 and care should be taken not to injure the ammeter by throwing more than one circuit upon it.

THE TELEPHONE PATENT SITUATION.—FURTHER NOTES.

Now that the American Bell Telephone Co. has lost the Government case and the Berliner patent has been declared void, manufacturers, before turning out battery transmitters will do well to inform themselves upon the state of the art and upon patents covering special forms of microphones as well as patents upon switching devices, used in connection with battery transmitters. Perhaps the broadest patent touching telephone circuits is that of T. A. Watson No. 202,495, dated April 16, 1878. The claims of this patent and comments thereon will be found in "The Telephone Patent Situation," (a reprint of five articles from THE ELECTRICAL ENGINEER), also in THE ELECTRICAL ENGINEER of Nov. 14, 1894. This patent already figures in two suits brought by the Western Electric Co. against one company in Boston and another in Chicago. The scope of this patent does not seem to be understood, as it appears to be generally thought that a non-infringing magneto bell will clear it. This is not the case however. Non-infringing magneto call bells have been made for years by the Viaduct Mfg. Co. of Baltimore, Md. and the Utica Fire Alarm & Electrical Co., of Utica, N. Y., and are now supplied by these companies and one or two others. The infringement of the patent above referred to consists in the combination of any magneto bell with a telephone circuit, when such combination is made in the usual way. If the magneto generator is out of circuit, or one side of the generator open, or if it is shunted out during conversation, such a combination is apparently an infringement; this is especially the case if the telephone be cut out during the operation of ringing. If, however, the magneto generator and bell are permanently in multiple across the mains of the talking circuit, and the telephone is adapted to be thrown out or in, such an organization infringes the bridging bell patent of J. J. Carty which has been purchased by the Bell Co. It will be well for manufacturers to avoid the above described organization of circuits if they wish to avoid suit.

The broad patent on the use of the induction coil connected with a battery transmitter expires Jan. 15, 1895. A most important patent, however, owned by the Western Electric Co. covers the combination of a switch (whether automatic or not) with an induction coil. The patent referred to is that of T. A. Watson No. 270,522, of Jan. 9, 1883, and it therefore has five years more to run. The claims of this patent are as follows:

1. In combination with suitable contact-points and springs electrically connected with the *call-circuit* and the primary and secondary circuits of a transmitter, the latter circuit including the hand-telephone, a lever electrically connected with the main line in a telephone-circuit, substantially as described, to bring in the hand-telephone and transmitter and break the *call-circuit*, or to cut out the hand-telephone and transmitter and establish the *call-circuit*, accordingly as the lever is moved in one direction or the other.

2. In combination with suitable contact-points and springs electrically connected with the *call-circuit* and the primary and secondary circuits of a transmitter, the latter including a hand-telephone, a lever electrically connected with the main line and provided with a hook to support the hand-telephone, and a spring tending to overcome the weight of the hand-telephone, substantially as described, to bring in the hand telephone and transmitter and break the *call-circuit*, or to cut out the hand-telephone and transmitter and establish the *call-circuit*, accordingly as the hand-telephone is removed from or hung upon said hook.

3. In combination with suitable stops connected with the primary and secondary circuits of a transmitter, the latter including the circuit through the hand-telephone, a lever electrically connected with the main line and adapted to support the hand-telephone, and provided with a spring tending to overcome the weight of the hand-telephone, substantially as described, to complete the local circuit through the transmitter, and at the same time connect with the main line the secondary circuit through the transmitter and hand-telephone by taking the hand-telephone from the hook.

4. In combination with a magneto-generator, a main-line tele-

phone-circuit and a shunt-circuit passing through the magneto-generator, the push-button U to break the shunt-circuit, substantially as described.

5. A switch-lever and contacts for connecting with the line-wire either a telephonic circuit or a call-circuit, according to the position of the switch-lever, in combination with the magneto-generator, its shunt and push-button, the said magneto-generator being connected with the call-circuit, substantially as described.

6. In a telephonic circuit, the spring-hook D, adapted to support the weight of the hand-telephone, in combination with the contact-springs s^1 , s^2 , and s^3 , connected with the transmitter hand-telephone and a signaling-circuit, substantially as described, for the purpose specified.

7. In a telephonic circuit, the spring-hook D, adapted to support the weight of the hand-telephone, in combination with contact-springs s^1 , s^2 and their connections, substantially as described, to automatically establish the primary local circuit through the transmitter, and at the same time bring into the main line the circuit through the hand-telephone and the secondary circuit through the transmitter by taking the telephone from the hook.

8. A switch-lever connected with the main line of a telephonic circuit and movable in either direction, in combination with the contact springs s^1 , s^2 , s^3 , the transmitter, the hand-telephone, a signaling-circuit and suitable connecting-wires, substantially as described.

By constructing transmitters which require no induction coil, and by using a magneto bell which is clear of the fourth claim of this patent, infringement may be avoided.

As to the Berliner or "Government Case" an appeal may now be taken to the United States Circuit Court of Appeals; whether the case would then be certified up to the Supreme Court is not altogether certain.

Should the Supreme Court reverse the decision of the lower courts in the Bate Refrigerator Case, the three Edison microphone patents of May 3, 1892, would then be revived, and such revival would have almost the same effect as though the "Government suit" had never been brought against the Berliner Patent, and that patent were now in force. However as the Edison microphone patents were also delayed in the Patent Office along with the Berliner application, it would seem that even were the Bate case now decided favorably to the interest of the American Bell Telephone Co., these patents would suffer as much from the alleged fraud involved in this delay as has the Berliner Patent. The Government could bring another suit to annul these microphone patents, or in a suit for infringing them the defendant could set up the same claim of fraud which the Government has just successfully established in the Berliner Case. There would be one disadvantage, however, to the new manufacturers of battery transmitters; as the Berliner Case now stands, it is absolutely useless as a basis upon which to bring suit or even harass people until it shall have been reversed by the United States Circuit Court of Appeals—which reversal is not at all likely. If, however, the decision in the Bate Case, which is expected within the next month or two, should be favorable to the American Bell Telephone Co., there would be an instant opportunity to sue manufacturers of variable pressure carbon transmitters all along the line, and keep down the number of such manufacturers through the sheer expense of litigation until a final decision in both the Berliner and Edison cases could be reached.

The most important Edison microphone patent, which would be revived by a decision in the Bate Case favorable to the Bell Co., is the patent of Thos. A. Edison, Application filed July 20, 1877, Patent issued, May 3, 1892. Patented in England, July 30, 1877, No. 2909:

Claim:

In a telegraphic apparatus operated by sound, the combination, with the diaphragm, of one or more contact-points of plumbago or similar inferior conductor in the electric circuit, whereby the rise and fall of electric tension is proportionate to the pressure exerted upon the said point or points by the diaphragm, substantially as set forth.

The claims of the other two Edison patents, No. 474,230 and 474,232 were given in full in THE ELECTRICAL ENGINEER of January 24, 1894, page 63.

SHALL CURRENT OR LIGHT BE SOLD BY CENTRAL STATIONS?

BY J. H. VAIL.

I have read with unusual interest the editorial on "Current vs. Light," and also the interview with Mr. Edison, appearing in *THE ELECTRICAL ENGINEER*, of Nov. 28, concerning the conditions under which electric current or light should be supplied from central stations to consumers. From long association with the Edison interests, I have the highest regard for Mr. Edison's views on a matter of this kind. It is apparent, however, that the rapid developments of the past few years have materially altered the conditions under which the manufacturing and supplying of electricity in a commercial way is conducted.

A list of the uses to which the modern central station electrical output is applied would cover nearly every known application of lighting, heating and power service. The local electric company has become a general manufacturer of electrical energy, and in large commercial centres has practically lost all control of the devices to which the current is applied. In other words, the central station manager devotes himself to supplying the required current to the consumer through the meter and at the standard pressure.

The electric light service is therefore rapidly approaching a field of action corresponding to that now occupied by the gas and water companies. This is not going backward, but forward; the tendency of the times being toward specialism. Formerly, the electric light company was obliged not only to instruct its prospective customers in the advantages and uses of electricity, but also to supervise all wiring jobs; inspect and test safety fuses, and decide upon the lamps, motors or other devices which might be connected on the system. All this is rapidly changing; the consumer now summons an engineer or contractor, who offers advice and installs the wiring system; the underwriters attend to the safety devices, insulation and method of wiring; the local company places the meter. It remains only to decide upon the devices to be employed for transforming the electrical energy into light, heat and power.

Confining our attention to lighting appliances we find on the market an infinite variety of arc and incandescent lamps, suited to constant potential circuits. For each style is claimed some feature of superiority over the others, such as low initial cost, economy of current, greater brilliancy, absence of blackening, long life, resistance to vibration, etc. There are already cities in the United States where one can buy at the grocery or crockery stores, or other depots of supplies, such incandescent lamps as he may desire. In fact, the incandescent lamp is rapidly becoming a staple article of general merchandise, as are the oil-lamp chimneys and burners, gas burners, lava tips, etc., for those methods of illumination.

Now, then, what kind of a lamp shall the consumer buy? If the central station is to sell *light* rather than *energy*, it must be in a position to dictate what lamp shall be used; but this power is steadily slipping away from it. Heretofore lamp manufacturers have catered to the central station managers. The time has come when they must begin to supply lamps for competitive sale direct to the consumer, so that, from now on, the manufacturer who can furnish the lamps which the *consumer* wishes to buy will reap the largest reward.

We can readily appreciate the propriety of this new condition. In the beginning, the consumer was ignorant of things electrical, and consequently not a safe judge of what he really needed; but now, after fifteen years' education, he ought to know pretty well which lamp is best suited to his individual requirements. With the current supplied at a standard electromotive force to the consumer the latter will readily learn the trick of using a lower volt lamp, if he desires greater illu-

mination, and a higher volt lamp if long life is the desideratum.

And, after all, the central station company is the gainer. It has less petty but expensive detail work outside of the station to attend to. The large wiring force disappears, leaving only a few "trouble men" and meter men to attend to the consumer. The universal introduction of meters stops the unpaid-for use of energy, and leaves the manager free to apply himself uninterruptedly to the attainment of higher economy in manufacturing and transmitting electrical energy. It is apparent that such a condition of affairs must lead presently to cheaper and cheaper electrical meter rates. Why should we desire to thwart a manifest destiny working so continuously to our advantage.

COMPRESSED AIR TRANSMISSIONS WITH ELECTRICALLY HEATED COMPRESSED AIR ENGINES.

BY

Thos. J. F. Fay

A question which has long been of moment in the practical application of compressed air, for actuating engines, is: How can the temperature in the cylinder of the engine be kept above the freezing point, and at the same time the air be worked expansively at such pressures as to otherwise produce economical results? It has been determined that the temperature of the expanding air, in a cylinder falls 71° C., with a cut-off at $\frac{1}{2}$ stroke and 140° C., cutting off at $\frac{1}{3}$ stroke. Considering the initial temperature as 20° C., it is not hard to believe, unless some special method is employed for keeping the temperature up, that the engine will be more effective as an ice machine than as a power generator. For the most part, at least in this country, it has been customary to work the air at full stroke, or nearly so, at moderate initial pressures, thus avoiding the ill effect of cooling.

Compressed air can never become a favorite for general purposes, however, while this practice is persisted in, for the very excellent reason, that it cannot compete with other methods, from the point of view of economy. For instance, it would be hard to believe that the efficiency of a non-expansively worked compressed air engine is better than 50 to 60 per cent., whereas, if worked expansively, we might credit it with an increase in efficiency of 25 per cent. at ordinary pressures; and furthermore, if an effective means, free from complication, could be found for counteracting the ill effect of temperature reduction, an even better result would be possible.

All that remains, therefore, to make compressed air engines highly successful, as well as efficient, is to place a resistance coil around the cylinder of the engine in such a way as to cause the cylinder to be kept heated when a current of electricity is sent through the coil. The source of the current is a dynamo actuated by the engine, and as the dynamo need only be very small, the power absorbed by it will be but a small percentage of the saving effected by its use. Presumably the simplest way would be to wind over the cylinder of the engine a properly proportioned coil of German silver wire, depending upon the air space for insulation; the wire constituting the coil being bare, and wound on strips of porcelain so placed as to effect the desired result. Over the coil may be placed a magnesia tube, to prevent radiation.

In compressors with jacketed cylinders, the cooling process is not so difficult, for the reason that cooling liquids may be circulated around the cylinders in pipes, thus keeping the temperature in the cylinder fairly low. This might be done by connecting up a small power pump

with it and working the pump by the prime mover, placed to actuate the compressor, having of course a supply tank for the liquid, very much as is done in refrigerating processes.

We should need, then, in such a system as the one described:

- (a) A prime mover, preferably water power.
- (b) An air compressor with an auxiliary pump, with tank etc., for the cooling process, actuated by the prime mover (a).
- (c) A suitable pipe line connecting the compressor with the source of power.
- (d) One or more compressed air engines with auxiliary dynamos, for the heating process, actuated by the compressed air worked expansively, as described.

Assuming efficiencies as follows, we should be able to deliver at the engine pulleys 58.52 per cent. of the theoretical water power. Water wheel, 80 per cent.; compressor, 90 per cent.; pipe system, 90 per cent.; engines, 90 per cent. $100 \times .80 \times .90 \times .90 \times .90 = 58.52$ per cent. It is believed that 60 per cent. of the theoretical power of the water could be delivered in the system described even over a distance of five miles, with a properly constructed pipe line, for the reason that the loss in the pipe line will seldom reach 10 per cent.; and the fact that the air is worked expansively has two effects, the economy of the engine is much augmented, and the first cost of the plant is decreased for the reason, that not nearly so much air will be needed as when the engines are worked non-expansively.

GLASS FOR ELECTRICAL WORK.

BY

Robert M. E. Lloyd

A very interesting book on "The Glass Industry of the Last Twenty Years,"¹ by L. Appert and J. Henrivaux recently published in Paris contains some facts which should command the attention of those electrical engineers who look toward the future.

The book points to a long list of achievements which not only indicate something of the genius and enterprise of the present generation of glass experts, but which give us reason to hope for very great developments of this industry. Electrical engineering has much to gain by improvements in glass and some of the processes described in this book are worthy of prompt consideration by the electrical profession. Heretofore, the use of glass in electrical work has been confined chiefly to telegraph insulators, incandescent lamps and battery jars, but now we are confronted with the possibility of extending its use to subway tubes, manholes, lamp posts, large storage battery tanks, switch boards, the walls, floors and roofs of electric light stations and possibly to the tubular tunnels for underground railways.

These things have been made possible by the cheapening of glass itself, the improved furnaces for melting it in great quantities and by improved methods of molding it. The old way of making glass was in small crucibles; now it is made in immense tank shaped furnaces, some of them 100 feet long by 30 wide by 10 feet deep and no limit to the size that they may reach. The raw materials are put in one end, and the glass comes out at the other. It is continually flowing and never allowed to cool from year to year. Glass ware with the exception of plates cast on flat tables was formerly all either blown or pressed and it was impossible to blow a very large object, and more difficult to press it; but M. Appert has developed a method of molding it which is applicable to objects of any size and a great French firm are now placing on the market bath tubs,

sanitary pipe, etc., and storage battery jars made under his patents.

Certain features of his molding method make the more perfect annealing of glass possible and it is marvelous to see the great strength possessed by a piece of heavy glass pipe well annealed. Of course, when glass pipes are mentioned, the question of good joints at once arises, but it is needless to say that Mr. Appert has taken good care of that problem, and that an entire system of subway construction has already been developed by him. The cost of such pipe need not exceed that of iron and its advantages are particularly apparent in these days when so many corrosive influences are present underground.

Storage battery work may also be benefitted by the ability to obtain heavy glass jars of great dimensions, and almost any engineer may think of some place where he could readily use a large glass tube or a heavy vessel with the qualities of glass. There is nothing else in the world so durable, so clean, so good for insulation, not to speak of transparency and resistance to action of acids. One has only to see some of the slabs of polished plate glass, 40 feet square made at St. Gobains to realize the beauty of glass as a material and if there is to be another age after the wooden age and iron age are past, it will probably be the glass age.

It is true that among the lost arts some of the results of Persian enameling have not altogether been reproduced, but a glance at this book will convince those most prejudiced against glass that we have entered upon an era of rapid progress in the application of a material which has long been deftly used but little understood and comparatively little appreciated.

The book describes methods of soldering glass to metals and tells something about lenses for projectors which is interesting to electrical engineers, but it tells a good deal more that will catch the popular mind. It gives some drawings of a complete glass dwelling house and a design of a glass portiere and has some chapters on art glass, also on glass smoke stacks, glass tables, wine tubs and many other things, besides much interesting technical information.

ELECTRICAL MACHINIST PRACTICE.—XV.

BY

James F. Hobart

Electrical machinery needs particularly good lubrication, chiefly because the speed at which it runs is great. Other types of electric machines are made wholly or partly automatic, and are required to run for long periods of time with very little attention. In loose pulleys, especially, perfect lubrication is a necessity, and the device illustrated in Fig. 68 goes far toward securing the desired results. It is one of the faults of the ordinary loose pulley that it cannot be oiled when the power is turned off, and the belt is on it. I say "cannot," but that is not always so, because the pulley may stop with the oil cups uppermost, but it doesn't very often.

In Fig. 68, this difficulty is obviated. Three oil cups *a*, *b* and *c*, are placed at the apexes of an equilateral triangle, and the pulley cannot stop in such a position that oil cannot be introduced through either one or the other of the three cups. The cups are screwed into a ring which is driven onto the pulley hub. This ring covers the annular channel which is turned in the end of the hub as shown. The oil cups stand directly over this channel when the ring is in place, and the channel is cut deep enough to reach the holes *h*, *f*; which are drilled through the entire length of the hub, as shown at *d*, *e*. The thin shell of metal between the holes, and the bore of the pulley, is chipped and filed away, and some felt is forced tightly into the longitudinal

(Continued on page 518.)

1. "La Verrerie depuis Vingt Ans." Paris, E. Bernard & Co.

THE ELECTRICAL ENGINEER.

[INCORPORATED]

PUBLISHED EVERY WEDNESDAY AT
203 Broadway, New York.

Telephone: 1323 Cortlandt.

Cable Address: LENGINEER.

Geo. M. Phelps, President.

F. R. COLVIN, Treas. and Business Manager.

Edited by

T. COMMERFORD MARTIN and JOSEPH WETZLER.
Associate Editor: GEORGE B. MULDAUR.New England Editor and Manager, A. C. SHAW, Room 70-630 Atlantic Avenue,
Boston, Mass.Western Editor and Manager, C. KAMMEYER, 1439 Monadnock Building, Chicago,
Ill.New York Representative, 208 Broadway, } W. F. HANKS.
Philadelphia Representative, 916 Betz Building, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada	- - - - -	per annum, \$3.00
Four or more Copies, in Clubs (each)	- - - - -	2.50
Great Britain and other Foreign Countries within the Postal Union	- - - - -	5.00
Single Copies,	- - - - -	.10

[Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1888.]

EDITORIAL ANNOUNCEMENTS.

Communications suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.

VOL. XVIII. NEW YORK, DECEMBER 26, 1894. No. 347.

CONTENTS.

EDITORIALS:—		PAGE
A Check—Berliner Patent Declared Void.....		516
Electricity in Agriculture.....		517
Uniformity, for Heaven's Sake.....		517
ARTICLES:—		
Recent Electric Plowing Experiments in Germany. (Illustr.).....		511
An Economical Series Street Lighting Switchboard. (Illustr.).....		512
The Berliner Patent Situation.....	A. J. FRANKFORTH	513
Shall Current or Light be Sold by Central Stations?.....	J. H. VALE	514
Compressed Air Transmissions with Electrically Heated Compressed Air Engines.....	T. J. FAY	514
Glass for Electrical Work.....	R. MOA. LLOYD	515
Electrical Machinist Practice.—XV. (Illustr.).....	J. F. HOBART	515
ELECTRIC TRANSPORTATION DEPARTMENT:—		
The Montreal Street Railway System. (Illustr.).....		520
Brooklyn Fender Resolution Vetoed.—A Car with Four Motors.—Brooklyn Trolley Accounts....An Electrically Hauled Fire Wagon.—Carrying Policemen Free.—County Electric Road in Ohio.—The de Bover System of Electrical Canal Boat Traction.—A Mavor & Coulson Sailing Electric Launch.—No Standing in Street Cars.....		523
Miscellaneous:—		
On the Production of Rotary Magnetic Fields by a Single Alternating Current. (Illustr.).....	A. GUTMANN	524
A Pioneer Lighting Manufacturer.—Elliott P. Gleason.....		525
NEWS AND NOTES:—		
To Revoke a Telephone Franchise.....		519
A Curious Magnetic Phenomenon.....		525
Automatic Electric Alignment Indicator.....		525
"Coalport Cullings".....		525
Electric Cooking at the Annual Dinner of the Institution of Electrical Engineers.....		525
Displacement Current Phenomena.....		525
The First Direct Connected Arc Light Station in Chicago.....		526
Municipal Electric Inspection in New York.....		527
Bidding for a California Franchise.....		527
SOCIETY AND CLUB NOTES:—		
A. I. E. E. Meeting.....		527
Brooklyn Electrical Society.....		527
LEGAL NOTES:—		
W. U. Must Issue New Stock to Replace Lost.....		527
LETTERS TO THE EDITOR:—		
Underground Work.....	A. R. FOOTE	527
LITERATURE:—		
Kapp's "Electrical Transmission of Energy and Its Transformation, Sub- -distribution and Distribution".....		527
INVENTORS' RECORD:—		
Classified Digest of U. S. Electrical Patents Issued Dec. 18, 1894.....		528
TRADE NOTES AND NOVELTIES AND MECHANICAL DEPARTMENT:—		
Western Notes.—Philadelphia Notes.—Southern Notes.....		528
Mr. J. W. Godfrey and Hishbrshaw Wire.—New Kelsch Arc Lamp Hanger Board (Illustr.)—Electricity in the Banner Mine, Oroville, Cal.— Telephone System for the Interior Department.—The Day It was Laid.—Fixtures Wanted for Government Buildings.—Electrolytic Copper.....		529
The Bolton Car Seat.—Sales of W. H. Fleming & Co.—The Central Elec- -tric Co.'s Catalogue Supplement.—Divideads.—New York Notes.— New England Notes.....		530

A CHECK—BERLINER PATENT DECLARED VOID.

THE decision of the Circuit Court of the United States, District of Massachusetts, in the "Government Suit" to annul the Berliner patent of 1891, (the full text of which was sent out as a supplement with the regular edition of THE ELECTRICAL ENGINEER of December 19) in which Judge Carpenter concluded that a decree should issue voiding the patent and ordering its cancellation, has been the leading topic for a week in electrical circles and has received widespread notice in the daily press. Comment more or less intelligent—chiefly the latter—has been rife. Readers of THE ELECTRICAL ENGINEER have been kept fully informed of the inception and progress of the suit and doubtless perceive that the Circuit Court decision against Berliner and the Bell company is a decided check in the hitherto triumphant course of that company. Unless reversed on appeal—apparently an unlikely contingency—the decision of Judge Carpenter divests the Bell company of fundamental patent control of the practical art of telephony. There is some possibility of their regaining a partial control if the Edison carbon transmitter patents of 1892 be resuscitated through a favorable judgment in the Bate case by the Supreme Court. It will be noted that the court found the circumstances of the Berliner patents of 1880 (a receiver) and of 1891 (the transmitter) such as to bring them under the ruling of the United States Supreme Court in *Miller v. Eagle Mfg. Co.* [See THE ELECTRICAL ENGINEER, Vol. XVII. No. 301, February 7, 1894.] Judge Carpenter says:

The transmitter and the receiver are identical in form and differ in function according as they are placed at the transmitting or at the receiving end of the telephone wire. It, therefore, appears that one of the functions of the device shown in the patent of 1880, namely the function of transmitting articulate speech, is identical with the sole object or function of the device covered by the patent of 1891 and that the device for effecting the transmission is identical in both patents. The patent, therefore, seems to me to be void and beyond the power of the Commissioner to issue.

We take leave to congratulate ourselves on having so closely approximated the view of the learned judge, expressed in the first sentence above, as to say in this journal, January 24, 1894, touching the Berliner patent of 1891, that: "In the event of the Berliner transmitter patent being sustained, the condition of affairs from a purely theoretical and legal point of view will be interesting and complex for, whether the device infringe or not will depend upon whether the user places his mouth or his ear to the instrument."

In respect to the allegation of the complaint that the Bell company had purposely delayed adequate prosecution of the Berliner application, in order to defer the issue of a patent and so prolong their monopoly, the court says:—

That the unwarrantable delay thus caused was intended by the respondent corporation I can have no doubt. In matters of this consequence, involving the whole business of a company of so large capital and engaged in so large affairs, I cannot doubt that they were fully advised both as to the facts and as to the law; and I think "that their acts were so gross as to forbid any inference except that they dishonestly delayed" the issue of the patent, taking advantage for that purpose of the perhaps excusable willingness of the officials of the Patent Office to postpone the decision of a sharply debated question, in which a large public interest was involved, on the chance that a decision of the Supreme Court might supersede the necessity for a decision on their part.

The Patent Office people here get off with less severity of treatment than the telephone company.

The unusual sagacity and very superior ability shown for fifteen years by the managers and counsel of the Bell company are still to be counted upon to make the best possible of the present situation and of the future. The protection derived from patents has been one of their chief instrumentalities. That instrumentality has been

seriously impaired during the past two years. But it is not their entire reliance. They have possession of the field, about all the exchange and long-distance business of the country, and ample capital. Like the Western Union Telegraph Company, they have great strength without reliance upon fundamental patents.

One effect of the Berliner decision will probably be that, instead of a test suit against manufacturers of battery transmitters, the activity in litigation will be shifted to the Western Electric Company, which company is controlled by the American Bell Telephone Company, and which owns hundreds of detail patents. Their policy has been publicly announced as being aggressive in this respect.

The field for competing companies would seem to be in small towns, where there are now no exchanges, or where the present service is inadequate, and where such towns would appreciate trunk connections; something has already been done in this direction. New companies, judging from what they have already done, are likely to put their rentals down to a figure too low to insure their success.

Further notes on the telephone patent situation will be found in other columns of this issue.

ELECTRICITY IN AGRICULTURE.

SO much has been accomplished by the electrical inventor, the electrical engineer and the enterprising manufacturer within the past fifteen years that it would be unjust to accuse either one of them of neglect in seizing an opportunity to still further broaden the field of electrical application. But a survey of the present state of the industry brings out forcibly the fact that practically nothing has been done to adapt the electric arts to agricultural operations. In spite of the extent of our manufactures, statistics show that we are, preponderantly, an agricultural nation, and, as such, any improvement which can be effected, or any economy introduced, in the tillage of the soil must influence the status, and hence ought to command the attention, of the majority of our population. We do not here refer to the experiments which date back for many years, looking to the application of the current directly to the soil to influence the rapidity of germination of the seed and to increase the size and quality of the mature plant, nor to those experiments in which the electric light is employed for the same purpose,—although these experiments are well worthy of full consideration. We have particularly in mind the application of electric power to the numerous operations, beginning with the plowing of the field, the sowing of the seed, harvesting and preparation for market of the product of the field. We have, indeed, chronicled the success of this class of work carried out at the U. S. Agricultural Station at Sterling, Kansas, and at the Agricultural College at Auburn, Alabama, but we are sorry to say that, notwithstanding the excellent showing obtained in the application of the electric motor at these places, no general recognition of its great superiority over animal or steam power is at all discernible as yet. It is for this reason that we have given somewhat extended space in this issue to a description of some recent experiments made in Germany in the application of an electric plow, which we deem worthy of close study, not only by agriculturists, but, more especially, by the manufacturers of electrical and agricultural apparatus, for to them we must look in the first instance for the creation of the material for the farmer's use. The results show that plowing by electricity can be accomplished for less than half the cost with animal power, and that the mechanical difficulties have been entirely removed. We are well aware that financial considerations must, to a large extent, govern the application of electricity in farming operations, and that, notwith-

standing the working economy, considerations of first cost must be especially taken into account. It is therefore probable that a comparatively small minority of farmers will be able to meet the expense of an electrical installation sufficient for their individual needs, but, on the other hand, by the coöperation of a number of farmers, including all in certain districts, there ought to be no difficulty in carrying out a successful scheme for the utilization of electricity. The establishment of a central station plant, with conductors leading to the various points where the power is to be applied, the cost and expenses of operation of which are borne, pro rata, by the members in each district, presents an easy solution of the problem. The amount of power required in agricultural operations pure and simple is comparatively small, and such plants would by no means require large investments or entail heavy operating expenses. Even at the present time we can discern a way of starting this movement, by tapping the electric railway circuits of the country electric roads which are rapidly covering the surface of some of our States with a network of conductors.

UNIFORMITY, FOR HEAVEN'S SAKE!

WE print in another column the announcement of the first steps looking to the practical operation of a municipal electrical inspection department in New York City. This matter was brought up two years ago, but the Board of Apportionment failed to make the proper appropriation, and consequently the law has never been enforced. Special attention has been drawn to it lately through the insurance authorities, but we doubt very much the wisdom of the insurance interests in aiding this matter in the manner in which they have, considering the fact that unless special care is given to the appointment of inspectors the insurance interests will be jeopardized, instead of protected, as the experience of all electric light interests in this city has been anything but pleasant, where inspections have been made by inspectors holding their positions through political influence. It appears to us that what the insurance interests should have done and wherein they would have been absolutely consistent, and received the support of every electric light company, consulting expert, and contractor in the Metropolitan district, would have been the re-organization of the electrical staff of the Underwriters, and the placing of their own Bureau on a much better basis than it is now. The insurance people themselves ought to be able to see that their own interests are not protected under the present arrangement; and it appears to an outsider that it would have been far preferable to have made such changes as would have compelled strict adherence to the Standard Rules and Regulations as adopted by the various Boards, rather than to aid in the establishment of another Bureau which will only create additional confusion. At the present time electric light interests in this city are hampered in very possible way. The Board of Electrical Control is supported entirely by the electrical industries without any representation on their part; they are compelled to pay enormous rentals for subway service; they are then subject to inspection and supervision from the Underwriters, as represented by the New York Board, and by the Bureau of Electrical Inspection; and now they are to be met with a new City Bureau. It seems to us that it is about time that the electrical industries in this city, together with consulting engineers and contractors, should inaugurate some concerted action, and ascertain whether or not they have any rights in the case, or whether they are to be continually subjected to changes in rules and regulations, and to be constantly hampered and thwarted in their business by the opinions of various inspectors, some of whom are of questionable competency, and yet who occupy positions that give them power to dictate absolutely what shall and what shall not be done.

(Continued from page 515.)

slot thus formed. The felt conveys oil from channel *i*, and hole *e*, to the shaft. The ends of holes *d* and *e*, are closed by pine plugs as shown at *g*, and the channel *i*, is entirely covered by the tight fitting ring shown in the end elevation of the pulley. This self oiling loose pulley is used to advantage in elevator work.

Men who like to babbitt boxes are scarce. Fig. 69

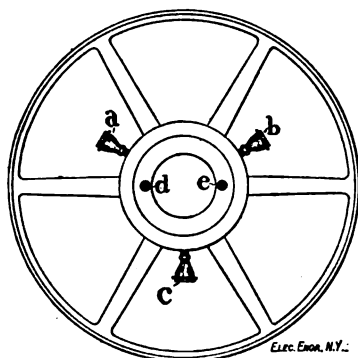
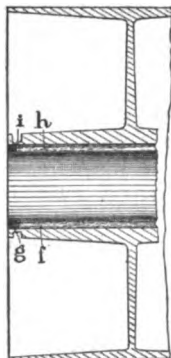
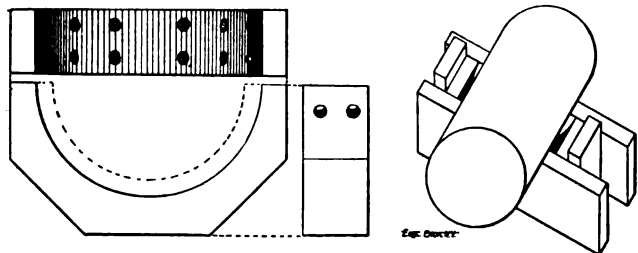


FIG. 68.



shows a box that is probably about as awkward to babbitt as one is apt to meet with in a week's travel. Babbitt must be run up to the dotted line shown in the end elevation. This seems an excessive thickness of babbitt, but the box is to be bored in a lathe, hence the necessity for a little extra thickness of lining. The babbitt metal is held in the box entirely by the hubs shown, and as some of them extend entirely through the metal, it is necessary to stop off these holes also. The usual way of lining a box of this kind, is to secure it to a wooden arbor with side and end pieces, as shown in Fig. 70. The side pieces must be sawed or whittled out to fit the pine arbor which has been turned up for the occasion, and the side pieces must be so adjusted that an even thickness of metal will be formed all around the arbor. After the pieces of board have been adjusted they are held then in place by means of some hand screws, three of which will be needed, one to hold the two end pieces and two to hold the side pieces. A weight must be laid on top of the arbor, or a couple more hand screws may be added to prevent the arbor from lifting when the babbitt metal flows under it. It is a good deal of trouble to so adjust all the pieces of board, the arbor, the box, and three hand screws, that no little hole may be left through which the metal may run. Even putty liberally applied will not always stop such leaks.

There is a much better way of babbitting this kind of box and others as well. Cut out a thin circular shell which will just slide into the box and fill it to the dotted lines,



FIGS. 69 AND 70.

Fig. 69. Get a barrel of "green sand" from the foundry, and keep it in a box in the babbit room, make one or two little two part flasks and keep them with the sand. To make this box, put the thin circular shell in place, and ram up a mold with the box for a pattern. Open the flasks, take out the box and remove the wooden shell. Gate the mold, replace the box *without the wooden shell*, close the

mold and pour with good hot babbitt. There is no chance for leakage as the only space is where the wooden shell came out. The wet sand will not cause the babbitt to fly, because there is no opportunity for any portion of the water to become enclosed in a portion of the hot metal, the sand is porous, and the water being slowly converted into steam, escapes and takes a great deal of heat with it.

I have seen a man try a box four times by the board, arbor, and handscrew method, and lose the pouring three times in succession. Not one in fifty is lost by the sand and flask method. It is also applicable to many other kinds of boxes, and babbitting in general. Short pipe arbors are very handy for this kind of babbitting; they can be rammed up in a flask, and the cast made about as quickly and with much greater certainty of success than when poured on an arbor with board sides and putty corners.

Generator and motor armatures are subject to some strains peculiar to themselves, and not present in other machinery. Torsional strains are to be expected, and are provided for as in other shafting. The tendency to lateral deflection is also provided for by a proper distribution of metal in the shaft. But the strains caused by magnetic attraction are almost entirely unprovided for. These strains being capable of acting almost instantaneously, are particularly hard to counteract. Under this title comes the magnetic strains caused by unequal field attraction and by armature cores being incapable of homogeneous magnetization, owing to peculiarities of the iron from which they are made. A considerable number of armature shafts break short off in a corner, say, where the journal bearing

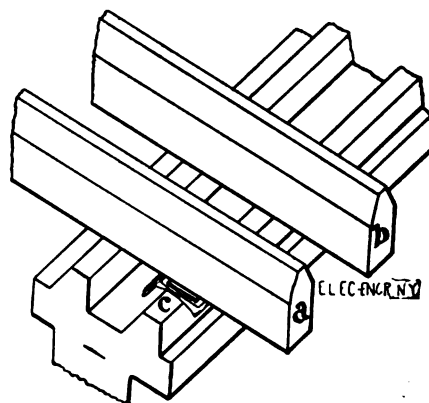


FIG. 71.

is turned down to fit the box. I have seen breaks of this kind where the breaking appeared to have been done by successive steps, the rust being absent, fresh, and old, in the zones of the break, each extending a certain distance inwardly from the circumference of shaft. It is, of course, possible to abolish the shoulder altogether and put a plain cylindrical shaft into the generator or motor, but some means, either a screwed or pinned collar, must be provided for holding the armature in place, and in the thread or pin hole will then be found the weakest, or breaking, point.

Aside from the unequal pull, and poor mechanical design sometimes found to cause trouble with generator and motor armatures, there is one thing which causes more trouble than it is credited with; and that is a lack of balance. Every machinist who turns up a commutator is expected, at least, to test the armature for standing balance. To do this, he usually puts two pieces of planed cast iron, *a*, and *b*, Fig. 71, across the ways of his lathe. The armature is then placed thereon (after the balancing ways have been levelled) and the armature put in standing balance by putting solder on the binding wire, or by securing one or more pieces of lead in the cavity between commutator and armature. There are several serious objections to this form of balancing ways. They are very unhandy, and levelling has to be done by putting pieces

of paper or card board under one end of one of the ways, as shown at *c*. This takes time, and every time the ways are put in place, after having been removed from the lathe, the levelling must all be done over again. To obviate this trouble the balancing ways, shown in Fig. 72, were constructed (and are used in his shop) by a motor repairer in New York city.

The engraving presents three views of the ways, or rather of one way, the other being shown only in the

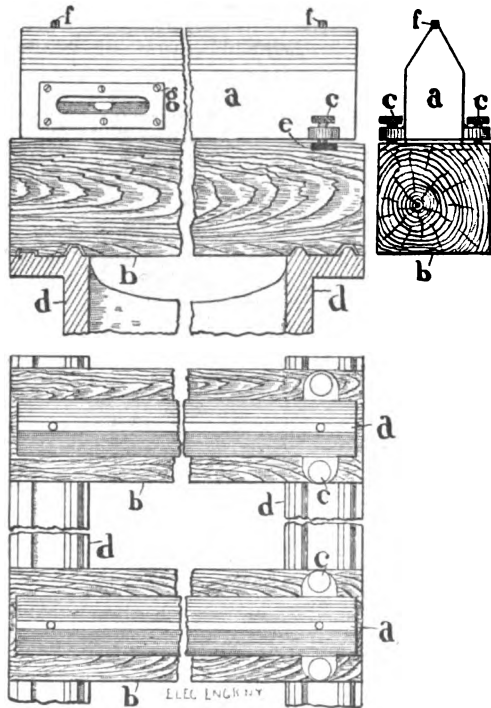


FIG. 72.

lower, or plan view. Upon the lathe bed *d, d*, are placed two hard pine blocks *b, b*. Mahogany would be better than pine, but the Georgia or Florida variety (don't try to use North Carolina pine) will do very well and do not cost nearly as much as mahogany. A thin bar of iron or steel *e* is cut in flush with the top of one end of each pine block; the blocks are about 5 inches square, but this depends upon the size of lathe upon which they are to be used. The thickness of block should be not less than one-fourth the width of the lathe bed upon which the blocks are to be used. The cast iron balancing ways are shown at *a, a*. Near one end of each bar, are cast the lugs *c, c*, which are fitted with milled headed screws for levelling the bars. A short level is placed on top of each bar in succession, in the shop where these ways are used, but the tool would be much better if it had a small space cored out at *g*, into which a short spirit level was set as shown. The levelling can be quickly done by means of these fittings, and a separate level need only be used to level across from one of the ways to the other. It is very necessary that the ways be levelled in this manner, and under no consideration should the attempt be made to use balancing ways unless the machinist is positive that they are level in two directions.

But however exactly an armature may be balanced upon ways, there is no certainty that the armature will run in balance when up to speed. And even when an armature runs smoothly at a certain speed, a change in the number of revolutions per minute may cause trouble. That is, a standing balance is not always (but may be sometimes) a running balance. The reason for this will be set forth by the following illustrations and description. In Fig. 73, the armature carries a certain excess of weight, say, three ounces, at *a*. The machinist balances

the armature by binding on a counter balance at *b*, three inches from the axis of the armature. A little figuring will show what takes place when the armature is put to work at 1000 revolutions per minute. But first it will be determined what weight must be added at *b*, to exactly balance three ounces at *a*, five inches from the axial line *c, d*. By the simple proportion $3 : 5 :: 3 : ?$ it is found that five ounces will be required at *b*, to balance three ounces at *a*.

While on the ways, the armature will stand in any position in which it may be placed, but when running at 1000 revolutions per minute the conditions are as follows:—When a weight tied to a string is whirled about a centre, the tension upon the string is measured by the formula

$\frac{W V^2}{g r} = \text{pull}.$
Here *W* = weight, *V* = velocity, *g* = gravity (32.2),
r = radius (length of string).

In the present example,

$$W = 3 \text{ ounces.}$$

$$V = \frac{1,000 \times 10 \times 3.141}{60 \times 12}.$$

$$r = 5.$$

$$g = 32.2; \text{ then:—}$$

$$\frac{W V^2}{g r} = 32.48 \text{ ounces, or 2.03 pounds.}$$

But with the 5 ounce counter weight 3 inches from axis, the formula would be:—

$$5 \left(\frac{1,000 \times 6 \times 3.141}{60 \times 12} \right)^2 \div 32.2 \times 3 = 2.33 \text{ pounds.}$$

Thus the balance is not exact, being .3 more than the pull of the heavy side. Practically it is about the same, but the slight difference above noted is not all there is lacking to secure a perfect balance by the method described. Fig. 73, shows the effect of this kind of balancing. The heavy spot at *a*, is supposed to be balanced by the counter weight at *b*. While the armature is on the balancing ways, supported by the axis *c, d*, a perfect standing balance is maintained, but when the armature is revolved up to speed, a new trouble enters.

A cylinder rotating about a longitudinal axis, not rigid, but allowed to locate itself freely, will revolve about the axial centre of gravity; not necessarily about the longitudinal axis of the cylinder. Consequently the weight *a*, and counter weight *b*, cause the armature to assume the new axis *e*, and the old axis describes the circles *f, g*. When the effort is made to confine *d*, and *c*, in rigid

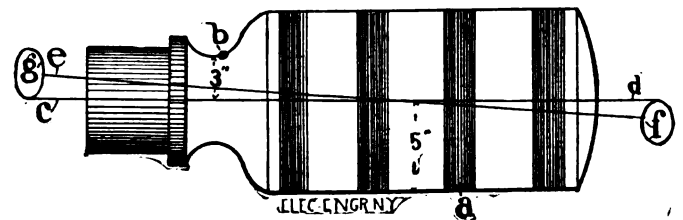


FIG. 73.

journal boxes, trouble is sure to result. This difficulty, and the proper means of preventing it, will be discussed in the next paper, together with a way of securing a perfect running balance.

TO REVOKE A TELEPHONE FRANCHISE.

A bill to revoke the franchise of the Southern Bell Telephone Exchange in Richmond, Va., was passed on Dec. 6, by one of the branches of the City Council there. Should the ordinance pass the Board of Aldermen and be approved by the mayor, it will not go into effect for twelve months.

ELECTRIC TRANSPORTATION DEPARTMENT.

THE MONTREAL STREET RAILWAY SYSTEM.

THE electric street railway system of the Montreal Street Railway Company, at Montreal, Canada, is a model one of recent construction, and is of more than usual interest owing to the fact that the next convention of the American Street Railway Association is to be held in that city. The system contains many interesting features and was designed to suit peculiar local conditions.

Montreal, the commercial metropolis of the Dominion of Canada, is located on the banks of the St. Lawrence River at the head of ocean navigation and with its suburbs has a population of nearly 800,000. The city is noted for its beautiful situation on a series of terraces at the foot of Mount Royal which rises to a height of 700 ft. above the river. The streets crossing the terraces have numerous and heavy grades, and even those running along the terraces parallel with the river have occasional grades. As examples, may be mentioned a grade on St. Lawrence street which rises 68 ft. in a distance of 1,500 ft. with a maximum grade of 8 per cent. On St. Lambert's Hill is a short grade of 11 per cent. and on Windsor street there is a rise of 70 ft. in a distance of 1,500 ft. with a maximum grade of 10 per cent. The frequency and severity of the grades is shown by the fact that out of ten routes there are only two which have no grades exceeding 5 per cent. The difficulties of operating the cars under these conditions are enhanced by the heavy snow falls in winter, and the success of the company in overcoming these obstacles reflects much credit upon its management.

The business districts of the city are near the river and are flanked by the residential quarters which are prevented by Mount Royal from spreading out far behind the city. The length of the city with its suburbs along the river is about eight miles and the average width is about a mile and a half. Rapid transit is thus of much importance on account of this long distance from one end of the city to the other. Until two years ago the only mode of railway conveyance was by horse cars which were intolerably slow on the cross streets where the grades are numerous. In winter the cars were replaced by sleighs, as it was impossible to keep the tracks clear of snow, with the appliances then available. Owing to the heavy falls of snow which in this latitude remains on the ground all winter and accumulates in the streets to a depth of from one to three feet, the general opinion was that it would be impossible to keep the tracks open in winter even with electric snow sweepers.

However, convinced of the advantages of electric traction, the city council invited tenders in May, 1892, for the privilege of

from \$2,500,000 to \$3,000,000; and 15 per cent. on all amounts above \$3,000,000.

The company also agreed to fix the prices of tickets at the following rates: 6 for 25 cents; 25 for \$1; and to school children, 10 for 25 cents. Tickets good between 6 and 8 a. m. and 5 and 7 p. m., 8 for 25 cents. Single fares to be 5 cents and transfers to be given to all routes. One of the conditions of the franchise was that if it were found to be impossible to operate the cars in winter,

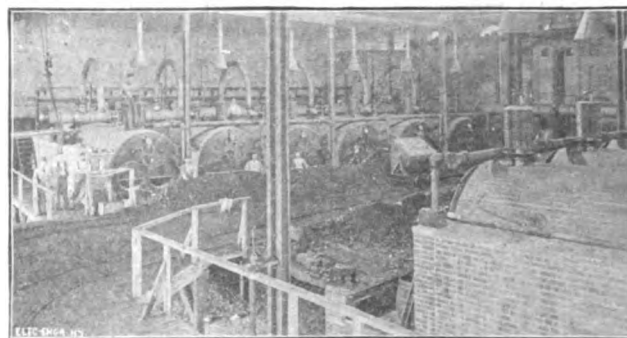


FIG. 2.—BOILER HOUSE, MONTREAL STREET RAILWAY CO.

sleighs drawn by horses should be used instead, but the company demonstrated by the first year's experience that electric cars could be run successfully all winter.

The company gave the contract for the reconstruction and equipment of its system for electric traction to Messrs. James Ross and Wm. McKenzie who began without delay the introduction of the trolley system.

THE POWER STATION.

The power station is located on William St., near McCord St., convenient to the coal yards as well as to the Lachine Canal, whence water for condensing is obtained, and about a mile from the centre of the system. The building, shown in Fig. 1, is a one story and basement brick structure with foundations 13 ft. wide of large flat stones laid in cement. The roof is of the truss type with steel principals and beams covered with 5 in. by 2 in. on edge spruce boards nailed together, as is usual in mill construction.

The floor of the first story, on which the machinery and the boilers are placed, is 7 ft. above the ground and 1 ft. above the highest flood level of the St. Lawrence River, thus removing any danger of interruption to the machinery should a flood occur. The building has a frontage of 209 ft. on William St. and a depth of 237 ft. at the main portion and is divided into two parts, one for the boilers and the other for the engines and dynamos.

THE BOILERS.

The boiler room, Fig. 2, measures 107 ft. by 114 ft. and contains twelve boilers of the double flue Lancashire type, made by Daniel Adamson, of Manchester, England, to which four more are now being added. The boilers have solid welded flues jointed together by Adamson's patent expansion joints and are constructed of $\frac{5}{16}$ inch steel plates with $\frac{1}{4}$ inch end plates. They are rated at 300 H. P. each on the basis of 80 lbs. of steam per horsepower hour and carry a working pressure of 125 pounds. Each boiler is fitted with a dead load safety valve, a six inch steam nozzle, a combined low water alarm and safety valve and a Government pop valve on the cover of the man-hole. The dead load valve is located nearest the front and the others follow in the order named.

The boilers are arranged in two batteries, and the gases from each furnace pass through the flues of its boiler, then return under the boiler and go back along its sides to the main flue. Thence they pass at a temperature of about 450 degrees into a Green economizer, which heats the feed water to a temperature of from 260 to 300 degrees. By means of a by-pass the gases can be admitted directly into the chimney if desired.

The draft is regulated at the chimney by two Locke automatic damper regulators, one for each battery of boilers. Four Northey pumps, two of which are spare, supply feed water to the boilers through duplicate pipes. The steam pipes are also practically in duplicate and are made of solid-welded tubes with rivetted cast steel

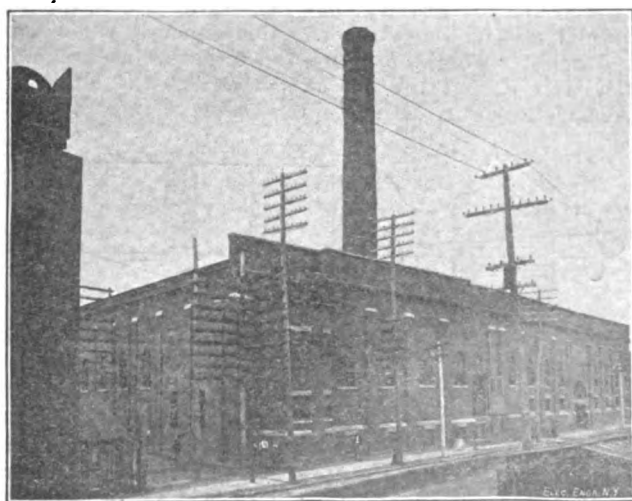


FIG. 1.—POWER HOUSE, MONTREAL STREET RAILWAY CO.

operating cars by electric power in the streets of the city and on July 19 of the same year awarded the franchise for thirty years to the Montreal Street Railway Co. which already operated the horse railways throughout the city. On its part, the company agreed to pay the city annually 4 per cent. on its receipts up to \$1,000,000; 6 per cent. on amounts from \$1,000,000 to \$1,500,000; 8 per cent. on amounts from \$1,500,000 to \$2,000,000; 10 per cent. on amounts from \$2,000,000 to \$2,500,000; 13 per cent. on amounts

flanges. The main steam pipe where it enters the engine room has a diameter of 18 inches and is provided with two steam separators one at each end of the pipe.

On the floor in front of each boiler is a door opening into a chute by which the ashes are conveyed to pits on the floor below. As this floor is level with the street, the ashes are easily removed in carts. A yard capable of storing 2,000 tons of coal is located next the boiler room and on a level with its floor.

The consumption of fuel per electrical horse power is very

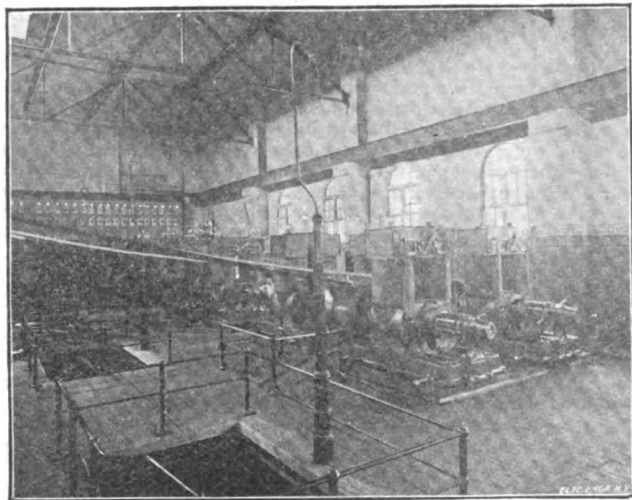


FIG. 3.—ENGINE AND DYNAMO ROOM.

satisfactory. For the months of August, September, October and November last, the pounds of coal consumed per electrical horse power have been as follows: 2.68, 2.94, 2.74, and 2.65, respectively. This low consumption of fuel must be largely attributed to the excellent results obtained from the two Green economizers. During the month of November, the average temperature of the feed water from the economizers was 285 degrees. The coal used is Cape Breton, run of mine, a bituminous coal of a somewhat low grade.

The chimney, which is one of the highest in the city, has a height of 190 ft. above the fire grate and is built with an air space extending to within 80 ft. of the top. The core is circular with an inside diameter of 9 ft. The foundations are 42 ft. square and are piled. The draft obtained is equivalent to the pressure of a column of water $\frac{3}{4}$ in. high.

ENGINES.

The engine and dynamo room, Fig. 3, is 235 ft. long and 80 ft. wide and is provided with two travelling cranes of ten tons capacity each, one for the dynamos and the other for the engines. The room is lit at night by over 200 incandescent lamps and during the day receives an abundance of light through the windows and the roof-light.

The equipment at present comprises six cross-compound condensing engines made by the Laurie Engine Co., of Montreal, and rated at 800 H. P. each. The cylinders are steam jacketed and have a diameter of 24 in. and 48 in., for the high and low pressure cylinders, respectively, with a stroke of 4 ft. The fly wheels which have a gross weight of 42 tons each, have a diameter of 22 ft., giving a peripheral velocity of nearly 4,900 ft. at 70 revolutions a minute. The wheel pits are constructed of sheet iron and are water-tight to prevent the entrance of water in case of a flood. The governors are of the Porter type and are capable of controlling the speed of the engines within 2 per cent. of the normal speed from no load to full load and vice versa. Each engine is also fitted with a safety governor having an automatic stop valve, which shuts off the steam supply when the speed of the engine increases 10 per cent. above the normal, and thus prevents the engine from running away if the ordinary governor should get out of order. The safety governors are provided with hand levers by which they can be put in operation and the engines quickly and conveniently stopped.

The engines are located in a row along that side of the room which is next the boiler room and have solid foundations of brick and cement carried down from 6 ft. to 8 ft. below the street level. At the end of the room is place for two additional engines with their dynamos, which will be installed when needed. It will be noted that some of the engines drive dynamos having considerably more than their rated capacity, but they have proved to be able to carry these loads without difficulty.

Under the engine and dynamo room is a high basement in which are a Northey and five Worthington condensers, one

for each engine. Water for condensing and other purposes is obtained from the Lachine Canal, 700 ft. distant, through a 20 in. main, and the waste water is returned to the canal through another main of the same size.

THE DYNAMOS.

The dynamos are arranged in a row opposite the engines and comprises twelve No. 80 Edison generators of 200 K. W. capacity each and six multipolar generators of 300 K. W. capacity each, all built by the Canadian General Electric Co. The twelve Edison generators are driven by three of the engines, each of which drives four generators by means of four 24 in. belts, arranged as a double tandem drive on its fly wheel. Each of the three remaining engines, drives two of the six multipolar generators by one 54 in. belt and one pulley. To accomplish this, two generators are mounted on the same bed plate with a pulley between them, belted directly to the engine as shown in Fig. 4. The armature shafts and the pulley shafts are in alignment and are connected together by two Hirt friction clutches. Thus one or both of the generators of each pair can be driven from the same pulley.

Under the generators is a continuous foundation running from one end of the building to the other and consisting of a brick wall of solid construction. The leads from the generators to the switchboard pass through the basement on racks with special porcelain insulators. The leads of the 200 K. W. generators consist of 36 cables, each having a cross-section of 250,000 circular mils. For the 300 K. W. generators, there are 18 stranded cables with cross section of 500,000 C. M. each.

THE SWITCHBOARD.

A novel and interesting feature of the switchboard, shown in Fig. 5, is that it is constructed of terra cotta lumber cemented with adamantine plaster. Besides the saving of expense effected by the use of these materials, the board has the advantage that it can be easily drilled and, furthermore, as it is made in one piece without joints, there is but little liability to breakage. An additional advantage is due to the absence of the iron frame required by a panelled board, but not needed by one of this construction. The board is 63 ft. long, 11 ft. high by about 9 in. thick and is located on a wide gallery 7 ft. above the floor, which extends nearly all the way across the front of the room. Around the edges, is a wide moulding of polished cherry, and the front is covered with enamel so that the board presents a very handsome appearance.

The front is illuminated by 43 incandescent lamps, one over the instruments of each circuit, which are of the Westinghouse pattern. At the end nearest the dynamos, are the twelve circuits from the Edison generators, each provided with an ammeter, a triple pole switch, an automatic magnetic circuit breaker and a switch for opening the shunt circuit of the dynamo, operating through a resistance.

The instruments for the six multipolar generators are the same, but are of a larger capacity and are located next on the board. The rheostats for regulating the generators are under the floor of the gallery and are operated by shafts extending upwards through the floor. Each rheostat is directly below the instruments of its particular generator. The remainder of the board is occupied by the instruments of the twenty-four feeders for feeding the system which is divided into nine independent sections, each

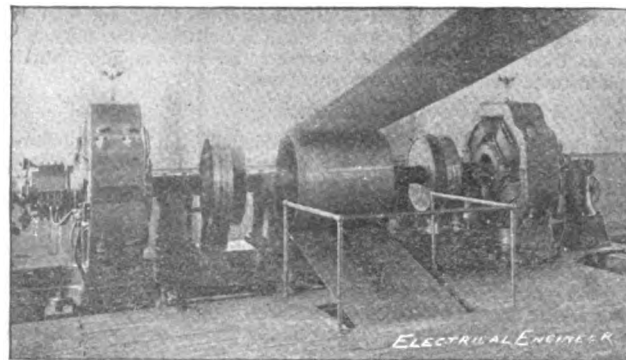


FIG. 4.—TWIN MULTIPOLAR GENERATORS.

controlled at the power house. Each feeder has an ammeter, an automatic magnetic circuit breaker and a switch.

The voltmeter and the main circuit ammeter are Weston station instruments and are mounted on a marble panel set at right angles to the switch board at one end of the gallery, in which position they can be seen from any part of the gallery. On the same panel are a Bristol recording voltmeter, a thermometer, a barometer and a clock.

The station is provided with a very complete and convenient

annunciator system for intercommunication between the switch-board and the engines. The system was manufactured and installed by C. W. Henderson, of Montreal, and by it the following signals can be sent to and received from any one of the six engines: Start; stop; stand by; full speed; slow down, and "O. K."

The connections are made at the back of the board where there is a space 10 ft. wide well lit by several windows. The feeders pass out of the building through a semi-circular bow window from which they are distributed in various directions. Protection

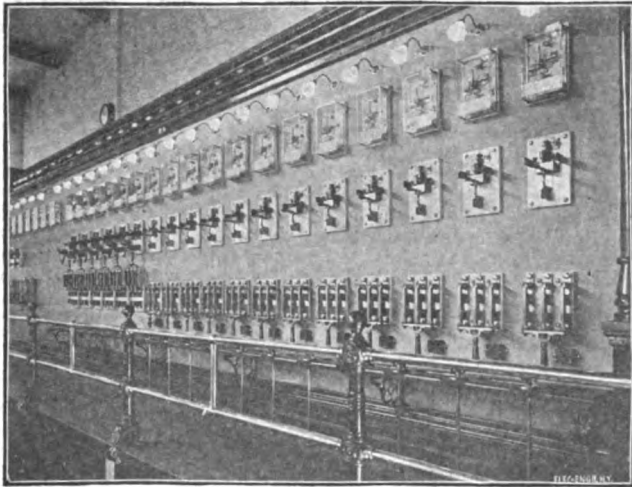


FIG. 5.—SWITCHBOARD OF TERRA COTTA.

against lightning is afforded by two tank lightning arresters, besides several General Electric magnetic blow out arresters and Wurts non-arcing arresters.

OVERHEAD CONSTRUCTION.

The overhead construction is of the standard type. Iron side poles of the Morris-Tasker sectional pattern are used and are set an average distance of 110 feet apart. Wooden poles are employed temporarily on some of the lines, but are being replaced as rapidly as possible by iron poles.

The trolley wire is No. 00 B. & S. gauge, of hard-drawn copper, and is supported by "West End" hangers with mechanical clip. The span wire is No. 9 B. & S., three ply galvanized iron wire, and is secured to the poles by Brooklyn strain insulators. The guard wires are also of No. 9 galvanized iron wire. Aetna section insulators and straight underrunning frogs and crossings are used.

The feeders are No. 0000 copper wire, and are both solid and stranded. Track return feeders of the same size are employed, but have only one half the carrying capacity of the trolley feeders, which is sufficient owing to the low resistance of the track return.

The bonding is done with No. 4 copper wires soldered to rivets driven in the rails and interconnected at short intervals. In addition the fish plates are large and each is bolted to the rails by six bolts so that the connection between the rails is good and the track return has a very low resistance.

TRACKS.

The system is being extended continually and the equipment increased to meet the growing wants of the service. The length of the tracks at present is $74\frac{1}{2}$ miles.

On streets paved with stone or wood blocks or asphalt, which have a concrete foundation, the rails are laid directly on the concrete according to the English method, Fig. 6, and thus differ from the usual construction on this continent. The track, which is a good example of this method of construction, is standing the heavy traffic and extreme cold very well; portions laid two years ago show no signs yet of yielding at the joints or giving out elsewhere.

The rails were imported from England and are of the grooved girder type, $6\frac{1}{2}$ in. high and weigh 72 lbs. to the yard. In laying the tracks, shallow trenches about 1 in. deep and wide enough to admit the rails, were excavated in the concrete foundations of the streets. The rails were laid in the trenches and levelled by thin pieces of oak. The rails on one side of the track were connected with those on the other side by iron rods, and a grout composed of equal parts of cement and sand was poured in the trenches so as to cover the flanges on the rails. Both sides of the webs of the rails were also filled with the grout to the width of the rails, the wood or stone blocks were then replaced and all crevices filled with grout. On streets paved with asphalt, scoria block headers were generally used next the rails.

At intersections and curves, the rails were spiked to wood ties bedded in concrete and on streets which have no permanent pavement the rails were also laid on ties. The track work at the crossings is a fine example of such work and was made by the Canada Switch Manufacturing Co., of Montreal, the sub-contractors for all intersections and special work. The intersections were constructed of girder rails connected by wrought iron fish plates. The joints were accurately made by machinery and the switch tongues were of hammered steel. The crossing at the corner of St. Lawrence and St. Catherine streets is the largest piece of track intersection work in Canada and contains 2,148 ft. of rails weighing 79 lbs. to the yard.

REPAIR SHOPS AND CAR BARN.

The main repair shop is conveniently located in the centre of the city, on Côté St., near which all the car routes pass. The shop is a two-story and basement brick building, 150 ft. by 115 ft., and is heated by steam and lit by incandescent lamps. The larger part of the upper floor is devoted to a shop for car body repairs and the remaining part is for armature winding and electrical repairs. In another building connected with the armature room by a bridge, is an oven for baking armatures and commutators. Here also are the stock room, pattern room and offices of the shop superintendents.

On the ground floor under the electrical repair room, is a machine shop which is very completely equipped with machinery, the power being supplied by an electric motor run by current from the trolley lines. The remainder of the floor is occupied by four tracks capable of accommodating 16 cars. Under each track is a pit 100 ft. long and over 5 ft. deep, which opens into the basement of the same depth so that there is ample room for working and many of the repairs can be made in the basement. Each pit is provided with a truck and hydraulic lift for handling the heavy parts of the motors. A transfer crosses the tracks of the trucks and connects with a small elevator which passes through the machine shop to the electrical shops on the floor above. The transfer also connects with a large electric elevator capable of lifting an entire car to the car body repair shops which are provided with a transfer. Adjoining the repair shops is a small brick car barn with a capacity for 20 cars and provided with shallow pits crossed by the basement transfer of the machine shops.

In the same location is an emergency station containing an emergency wagon and comfortable quarters for the men who are always on duty and respond to fire alarm calls, cars-off-the-track and any trouble calls. The station is provided with a signal gong connected with the city fire alarm system and a telephone. The store room for line material is conveniently located in the same building.

Car barns with pits and appliances for making ordinary repairs are located in three different places on the out-skirts of the system. Those at St. Henry and on St. Denis St. with a capacity for 54 and 87 cars, respectively, are very conveniently arranged and are worth special mention. They are solidly constructed of brick and stone and are lit by sky lights in the roofs. The whole floor area, except that occupied by the spaces between the tracks and the switches, is pit room. The floors of the pits have drain connections for drawing off water so that cars can be washed over the pits. The barns are heated by steam from boilers in annexes, where are located blacksmiths' shops, oil and store rooms, besides rooms for conductors and motor men and coal storage in the basement.

THE ROLLING STOCK.

The rolling stock consists of 180 motor cars and 95 trailers, nearly all of Canadian manufacture. The motor cars are equipped with series-parallel controllers and with Edison General Electric, Royal and Westinghouse motors. The cars are equipped with fenders and in winter are fitted with vestibules and heated by stoves. Blackwell trucks made by the Canada Switch Manufacturing Co., of Montreal, are used.

The rolling stock also includes 9 snow sweepers, of which 8 were made in the company's own shops and are equipped with

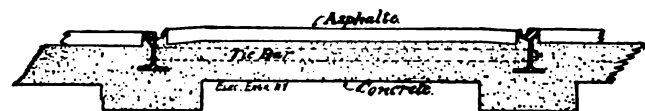


FIG. 6.—RAILS LAID IN CONCRETE.

motors of the company's own manufacture, and with "K" controllers, made by the Canadian General Electric Co. In Montreal where the snow remains on the ground all winter and accumulates on the streets to a considerable depth, it is not sufficient to keep the tracks clear of snow by the sweepers, but the snow must be removed in sleighs from the streets in which the cars run. In removing the snow, a layer 8 or 10 inches deep on each side of the track, is left for sleighs, which are the only vehicles used in winter. The company keeps its tracks clear with sweepers, and

shares the expense of removing the snow from the streets which is done by the city. Under these severe climatic conditions, every precaution must be taken to keep the tracks open, and the superintendent watches the reports of the weather bureau very closely. When a snow storm is predicted, extra men are engaged and everything is made ready to cope with it. An idea of the work and trouble created by a Montreal snowstorm may be inferred from the fact that in December, 1893, the total snowfall aggregated $40\frac{1}{2}$ inches.

FINANCIAL.

The capital stock of the company is \$3,000,000, with a bonded indebtedness of \$973,833. The net earnings for the year ending Sept. 30, 1894, were \$253,423, an increase of nearly 64 per cent. over the previous year, out of which two dividends of 4 per cent. were paid and \$37,354 added to the surplus.

In 1892 the number of passengers carried was 11,631,886 and in 1894 the number was 20,569,013, which figures show that the traffic has nearly doubled within the two years during which the trolley system was introduced.

The officers are L. J. Forget, president; G. C. Cunningham, manager and chief engineer; E. Lusher, secretary and treasurer; J. F. Hill, comptroller; R. C. Brown, electrical engineer, and D. McDonald, superintendent. Messrs. K. W. Blackwell and Jas. Ross, together with the president and manager, form the board of directors.

BROOKLYN FENDER RESOLUTION VETOED.

Mayor Schieren of Brooklyn, has vetoed the resolution of the city council requiring the street railways of the city to adopt and use such car fenders as should prove satisfactory to a special commission composed of seven members. Granting even that the council has the right to designate the kind of apparatus, the body created by the council would have no legal status.

A CAR WITH FOUR MOTORS.

A special dispatch from Amesbury, Mass., of Dec. 14 says: A new car was run out of the Briggs car factory yesterday, for the Gray Electric Railway Construction Company. It is a new thing in the way of motor, one being situated on each end, one at the top, and the other on the floor of the car. It is claimed by the inventor that but one-third of the power used in an ordinary car is required to run it. It was taken to Merrimac to be wired preparatory to its trial trip.

BROOKLYN TROLLEY ACCOUNTS.

The New York State Board of Railroad Commissioners has dismissed the charges of stockholder H. M. Thompson against the Brooklyn City Railroad Company, alleging that the financial reports had been doctored so as to deceive the stockholders. The Board finds that the company's connection with the Long Island Traction Company is in the interests of the stockholders, and that its accounts are all correct.

AN ELECTRICALLY HAULED FIRE WAGON.

A special dispatch of Dec. 15 from Newburgh, N. Y. says: Probably the first instance where a fire apparatus has been taken to a fire by electric power occurred here to-day. At 10 this morning Box 54 rang in an alarm. The companies with and without horses started up Broadway. One of those without horses was the "crab" of Washington Steamer, No. 4, a four-wheeled cart loaded with hose. As the "crab" was passing the power station of the Newburgh Electric Railway, Superintendent Thair suggested to the firemen tugging through the mud to take an electric tow. A passing car pulled up, the almost exhausted men tumbled into it, the "machine" was hitched on, and the quickest run to a fire on record was made.

CARRYING POLICEMEN FREE.

The Rochester N. Y. City Common Council propose to make an arrangement with the street railroad company by which it will carry, for a nominal sum, all policemen and detectives. This is an outcome of the Constitutional Amendment prohibiting the issuance of passes to public officers. Under that new law, policemen will have to pay fares the same as other people, and it is proposed to relieve them of this additional expense by having the city pay their fares, and, if possible, get a special low rate for that purpose. The Council want to encourage the practice of policemen getting homes in the suburbs where they can be of assistance in preserving order in the outlying districts, and they are willing to help by paying street car fare for the policemen if some arrangement as suggested can be made.

COUNTY ELECTRIC ROADS IN OHIO.

A mammoth electric-railway project is proposed by Martin Dodge of Cleveland, the president of the Ohio Road Commission of 1893, whose report quoted in THE ELECTRICAL ENGINEER at the time attracted so much attention a year ago, for the advanced position it took with regard to the construction of electric roads through the country districts. His latest project involves millions, but he is very confident that he will be able to carry it through. It is nothing short of a proposition to build a great network of electric lines all over Ohio at the public expense. He believes the electric road is the system of the future, and he would have the public construct lines in the same manner as canals and highways have been built in the past and are being built now. He thinks the time is ripe for an act under which the state and the counties may join hands, and construct electric roads between all the county-seats in the state, the lines to be operated by private enterprise on lease, after they have been built. He would have the counties pay half the expense of the immense work and the state the remainder. He estimates that this would require 4,000 miles of road and would cost over \$20,000,000. The estimate of \$5,000 per mile, which he fixed, is below the average, it is said, of the expenditure on the country lines now in operation in the state, and the work, done by the public, would still further increase this expenditure. Some of the critics of Mr. Dodge's scheme say that it would cost twice \$20,000,000, but the projector sticks to his estimates. He says, however, that even if it did cost more than he has figured, it would still be a first-class investment for the public.

THE DE BOVET SYSTEM OF ELECTRICAL CANAL BOAT TRACTION.

A trial of the de Bovet system of electric traction for canal boats recently took place on the fifth reach of the St. Denis Canal, France. A series electric motor actuated the towing pulley, a 14 mm. chain, placed at the bottom of the canal, being carried over the pulley to the extent of three-quarters of a turn, although half a turn suffices. A two-wire circuit running along the bank of the canal was connected to a 110-volt generator driven by a locomotive engine. The current was collected by means of two trolleys running along the wires and connected to the motor by a flexible cable, which was passed over a pulley at the top of the mast of the boat. The trial was completely successful, and showed that for an expenditure of 2,000 watts it was possible to make a 800-ton barge move at the rate of 2.8 kilometres per hour. The getting under way took place without shock, and the normal speed was rapidly reached.

A MAVOR & COULSON SAILING ELECTRIC LAUNCH.

The electrical engineering firm of Mavor & Coulson, of Glasgow, have lately had built for them an ingenious combined electric launch and sail boat. The hull is made of a double skin of cedar wood, laid on diagonally, the two layers crossing each other. The motor is placed towards the stern and low down, a wooden cover protecting it from injury. The necessary power is derived from a set of accumulators placed under the seats which extend round the sides of the boat. The supply of electricity to the motor is regulated by a switch under the control of the steersman. The batteries hold a charge sufficient to propel the boat at a speed of 6.88 miles per hour for 5.7 hours, or a total distance of 86.36 miles; or, at a speed of 4.5 miles per hour for 9.75 hours, a distance of 43.2 miles. The launch has round her a cork fender about 8 in. square. This is sufficient to support the launch when filled with water and with four passengers. She can also be sailed by lugsail and jib. The motor is of Messrs. Mavor & Coulson's make. It is of special construction, being manufactured under Sayer's patents, "which enable the weight to be reduced to about $\frac{1}{4}$ ths of that of the ordinary type, while the efficiency is increased." The motor also runs in either direction, the brushes automatically adjusting themselves. The dimensions of the launch are:—Length, 27 ft. 6 in. by 4 ft. 9 in. The weight of the boat and fittings is 14 cwt.; machinery, including cells, switches, etc., 1 ton 2 cwt.; awnings, fenders, etc., 2 cwt. 8 lbs.—total, 1 ton 18 cwt. 8 lbs.

NO STANDING IN STREET CARS.

The Industrial Council of Kansas City, Mo., received and approved recently an ordinance drawn up by a committee to protect passengers on street cars. The ordinance, which will be introduced to the council, asks that it be made a misdemeanor punishable by fine for a street railway company to allow passengers to stand on platforms or footboards of cars. The ordinance also asks that the companies shall be compelled to provide cars sufficient to seat everyone, and if they do not that they be held criminally negligent.

MISCELLANEOUS.

ON THE PRODUCTION OF ROTARY MAGNETIC FIELDS BY A SINGLE ALTERNATING CURRENT.¹

BY LUDWIG GUTMANN.

I wish to bring to your notice, a method of generating a rotary magnetic field by a single alternating current or its field, without condensers or choking coils. This is accomplished by a device brought out by me some three years ago. Its fundamental principle is hardly as yet appreciated; however, the World's Fair exhibits as well as literature of late, show that the device has attracted

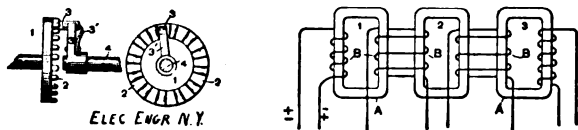


FIGS. 1 AND 2.

attention, and that several engineers have approached the principle involved.

I wish to refer to my motor and especially to its armature described in 1891.² Fig. 1 and Fig. 2 show the device. The former is principally used in the American patents, while the latter is given in the English patent of the same year. The novelty of the armature construction, lies in a winding containing closed sub-circuits; and another point is, that the closed circuits do not coincide in number with the poles of the field magnet.

Let us look into the device before us, and consider first its quality as a motor. Returning to Figs. 1 or 2, preferably the latter, which is simpler and easier to explain, we find that if we send into the field magnet coil an alternating current, the armature will turn through a certain angle and stop. This motion depends upon the position of the three closed coils with respect to the two poles. This same device can itself be self-starting if we make the poles far enough apart and the energizing current sufficiently strong, so that at the initial speed the armature is repelled at a certain rate. This initial speed changes with the number of poles, closed circuits and alternations. Let us take the first case and examine it. If we try to rotate the *armature* (as I shall call it hereafter), in a field of alternating polarity, we induce currents in the closed circuits, which establish poles, but these poles are alternating in nature, and owing to the motion imparted, and owing further to the permanent connections in the winding, the poles move or travel, with the latter. This accounts for the fact that if the field poles are close together the armature consumes power during its rotation through the alternating field; it acts as a dynamo and does not start from a state of rest. If we impart by mechanical means an impulse to the armature, currents are generated whose sum has a variable and principally negative value. The armature makes a few revolutions and places itself in a stable magnetic equilibrium, viz., in such a position, symmetrical if possible, as not to generate any currents, and hence not to induce any reactionary poles in the core. If, however, we impart to this armature a certain initial speed, which I shall call *the critical speed*, then it will continue



FIGS. 3 AND 4.

to rotate, with a tendency to reach a certain fixed higher speed. This initial impulse may be given by mechanical or electrical means.

Looking at the armature we see that it has a symmetrical winding, and as long as these closed circuits do not coincide with the number of poles of the field magnet (contrary to all synchronous motors built heretofore), other working positions are possible. The operation will take place as long as the sum of the armature currents have a positive value, since as far as the rotation is concerned it is indifferent which of the coils are doing the work.

An analysis of this new type of synchronous motor shows, first, that at synchronous speed the pole positions in the armature are

practically stationary relatively to the coils and core, and rotate with it. Secondly, that during a complete revolution of the armature, the field has reversed three times, that is, an odd number of times, hence, when the armature returns to its original position, after a complete revolution, it finds the field magnetization of reversed polarity. The magnetic field of the armature rotates in the opposite sense, one and a half times per revolution. Thirdly, that when the armature makes but one-sixth of a revolution per half-period, and the magnetic field of the armature in a complete revolution rotates three times in the opposite direction.

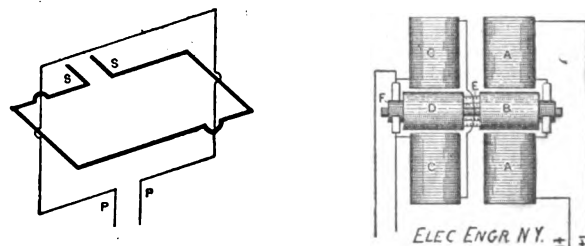
Looking at the device from a general standpoint, it will be clear that this particular armature construction embodies all the weak points of a synchronous, and all the strong points of the polyphase motor. The weak points are:—

1. That the machine will not start from state of rest in the form shown, because in Figs. 1 and 2, the coils act on one another differentially and have a variable and negative value; they are in magnetic stability when at rest, hence, no rotation can result.
2. The device has a small starting torque when rotated, owing to the differential action of the coils, which cause, with a small number of closed circuits, strongly oscillating or jumping poles, until a harmonic speed is reached.
3. The device when in rotation, is not reversible by simply changing circuit connections.

The strong points are:—

- First, that the motor develops polyphase currents in its own windings.
- Second, that therefore it is more difficult to pull it out of step as it has the capacity to stand, what I would term, magnetic slippage.

Let us assume that a certain coil, which should reach a given point to run harmonically, remains behind owing to a slower motion of the armature; in this event the coil ahead has to perform the function at the expense of a slightly heavier current. The loss of revolutions due to this action may be comparable to the slipping of a belt over a pulley. However, there is also a limit to the slipping. The armature should have some harmonic speed with respect to the alternations. Should it fall below the



FIGS. 5 AND 6.

lowest harmonic speed, then it will come to a standstill just like any other overworked synchronous machine.

Synchronism in a motor means nothing more or less than a magnetic flexible clutch. In contrast to this older form of synchronous motors stands the new one, which forms the subject of this paper and the machines operated by bi- or poly-phase currents. The mechanism for showing magnetic coupling for these latter types may be represented by Fig. 3. In this case, 1 represents a crown wheel the teeth marked 2; into these teeth meshes a catch 3 in a flexible manner, which catch is connected rigidly to shaft 4. Within the range of normal work, catch 3 would remain fixed between the two given teeth, but if the shaft 4 is overloaded, the flexibility of catch 3 will cause it to yield, and pull out of its position, drop in between some other two teeth, and continue to operate but at a slower speed. The greater the excess of work, the greater will be the slippage, and the more teeth will be jumped by the catch 3 in every revolution of disc 1. For the synchronous motor herein described, the overloading to the extent that it cannot reach the lowest harmonic speed, would be equivalent to the breaking of spring 3.

It will be remembered that Prof. Ferraris always, and Tesla sometimes, obtained a rotary magnetic field and rotation by influencing one coil carrying a primary current, by another at right angles thereto carrying secondary currents. Here we have two phases from a single source, Fig. 5. To obtain a multiple of phases we may take two or three iron cores A, and surround them with coils B, like the links of a chain, Fig. 4, so that the secondary coil of transformer 1, is the primary of transformer 2, and so on; or we may design a special core for a transformer, and create a rotary magnetic field by applying to one coil a primary current from the line, and to another coil a secondary current from a transformer, whereupon by the rotary field obtained, polyphased currents may be taken through other coils on the transformer. These methods have, however, one drawback, and that is that the phase will change more or less in lag with difference in load, while for many purposes it is most essential that for efficient working the phase should remain at the same constant angle. This desideratum has been accomplished by the device under con-

1. THE ELECTRICAL ENGINEER, vol. xii., Aug. 26, 1891, p. 230.

2. Abstract of a paper read before the American Institute of Electrical Engineers, Dec. 19, 1891.

sideration, and any suitable number of currents lagging in phase may be obtained from a single alternating current.

To obtain a rotary magnetic field in or by a stationary body, at least two electric or electromotive forces of definite phase relations, acting at an angle to one another and changing at periods harmoniously, are essential requirements.

If, however, we allow the body, or part of the same, to be movable, we may substitute mechanical rotation primarily as an adjuster of the periodicity and phase of one of the two forces; the fundamental relation between the two forces must in this case also be the same as in the other; namely, they must work in harmony and the periodicity and phase determines the periodicity and phase of the other of one force. If the second force is a current, it must be one of the same period or some harmonic of that period; if it is rotation, it has also to be synchronous or harmonic. We can now clearly understand why, when rotating the armature, Figs. 1 and 2, in an ordinary alternating current field we have no system of polyphase current and no rotary field, simply because the armature rotation does not stand in any relationship whatever to the alternations; but as soon as the speed does so, there are generated polyphased currents lagging in phase at a field angle, and a rotary magnetic field.

Up to the publication of this device some three years ago, synchronous motors had as many armature coils as field coils, and hence to obtain the value of the synchronous speed, all that was necessary was to divide the alternations of the armature current n by the number of field poles p of the magnet employed. But if the number of armature coils are not the same as the field poles, then the speed may vary from this synchronous speed and a modification is thought to be necessary. We would have to find the smallest common factor between field poles p and armature coils p' with which we have to divide the number of alternations to obtain the value of the lowest synchronous speed while the condition of slippage may allow for the lowest harmonic, the value $\frac{n}{p \cdot p'}$.

It will now be clear that motors can be designed having any desired variation of speed and have defined synchronous speeds or approach the indifferent relation.

The device has been given in the form of a diagram, and as it has been described as not self-starting, I wish now to state that it becomes self-starting as a series, a shunt or an induction motor in a field of single phase or polyphased alternating currents. Fig. 6 represents one of the earliest forms which have since been simplified to a considerable extent. The part A B, represents here a simple series motor whose armature B may be any Gramme or ring type, open or closed coil winding; the part C D, may be similarly constructed. Both armature windings B and D are connected electrically by 4 wires E at points of equal distance, which number of conductors E, may be reduced or increased, depending on the number of phase currents desired. Now send an alternating current into the series motor, part A B, preferably so that no reaction takes place from part D; then the armature will start from state of rest and will send current impulses into the D part winding, which becomes the more regular the more the armature has approached synchronous speed, where bi-phase currents will be established therein; these react on the field magnet core C, and for the purpose of maintaining the armature in this synchronous speed, the commutator F is applied to rectify the polyphase current; which continuous current may be used to energize the magnet C.

The fundamental principle disclosed, opens to us a very wide field for work. Not only are we enabled to construct motors almost as cheap and simple as continuous current motors, but there is in this principle involved the germ for the ideal distribution of power, inasmuch as we are enabled to collect the polyphase currents generated, or commutate them immediately at will. Finally I wish to call your attention to the fact, that the last figure is in reality a motor-generator, and it is therefore evident that the electrical energy supplied need not all to be transformed into mechanical power, but that a portion may be utilized in one of the modified forms named above.

A CURIOUS MAGNETIC PHENOMENON.

In the course of some experiments made at the Central Technical College, London, early in 1890, to investigate the nature of the field in the air gap of a magnet for a d'Arsonval galvanometer, Mr. C. O. Lloyd noticed that when a magnet is broken, and the pieces are put tightly together, there is not only a consequent point, or at all events a leakage of lines of force at the fracture, but there is an image or ghost of a similar consequent point, symmetrically situated with respect to the general shape of the whole magnet. Prof. Ayrton has recently repeated these experiments, and finds that fine iron filings and a rather strong field are necessary to bring out the effect. Mr. Lloyd appears to have obtained his diagrams just after removing a magnetizing solenoid carrying some thousands of ampere turns.

No explanation has yet been offered to account for the phenomenon,

AUTOMATIC ELECTRIC ALIGNMENT INDICATOR.

IN the erection of machinery, such for instance as steam engines, it is the common practice to adjust the parts to their proper positions by means of an adjustment line which is drawn taut between end supports, the several parts being properly set with relation to said line. To accomplish this, one or more gauges are employed measuring the proper distances from convenient finished surfaces to the adjustment line, so that when one end of a gauge is held in contact with such surface and the other just touches the adjustment line such surface will be properly located in the direction measured. In practice it requires considerable skill as well as delicacy of touch and eyesight to accurately locate the parts, the line being unavoidably deflected to some slight extent even by such contact with the gauge as will be detected only by an expert, thus rendering the operation tedious and difficult and liable to sufficient inaccuracy to materially affect the practical working of the finished machine.

To facilitate the operation of properly adjusting the parts with relation to the adjustment line and to eliminate the error apt to arise from want of sufficient delicacy of sight and touch in the operator, Mr. R. J. Snyder, graduate of Lehigh University and recently connected with the Cramp Ship Building Co., at Philadelphia, employs a device which positively and automatically indicates the slightest contact with the adjustment line.

This is accomplished by the use of a metallic line insulated at its ends from the machine to be aligned, the machine and line being connected through a battery and convenient form of current indicator in open circuit. The metallic gauge used in the adjustment of the parts of the machine relatively to the line serves to open or close the circuit. The slightest contact with the adjustment line is positively and automatically indicated by the passage of the electric current. The application evidently admits of various modifications to suit different machines, and has recently been put in practical operation.

"COALPORT CULLINGS."

The electric light plant that was to be put in has fallen through after getting the charter, etc. It is like all other enterprises that are started here.—*Du Bois, Ia., Express.*

ELECTRIC COOKING AT THE ANNUAL DINNER OF THE INSTITUTION OF ELECTRICAL ENGINEERS.

Mr. F. H. Webb, secretary of the Institution of Electrical Engineers, of London, in a letter to this country, speaks of the recent electrically cooked dinner of that organization as follows:

"Our Annual Dinner went off very well. We held it as last year at the Freemasons Tavern and we had the roasts and entrées cooked by electricity. It was quite a temporary installation as they have not even the electric light, and we expected great opposition from the 'Chef.' He was very funny when we went to see him with the manager first. He said he did not want to be killed as he had two grandmothers dependent on him. However after going to Mr. Crompton's place at the Brompton Road where they have electro-cooking on view he was quite reconciled to the idea of giving it a trial and in the end he and his staff expressed themselves as quite astonished and delighted. He was in fact quite converted."

DISPLACEMENT CURRENT PHENOMENA.

At a recent meeting of the Academy of Science of Amsterdam, Herr C. H. Wind read a note on the Kerr phenomenon. The author breaks up the electric current into two parts—a current of conduction and a displacement current—and to these attributes, as Lorentz has done, the Hall effect. He supposes, however, says *Nature*, that the electromotive force which constitutes the Hall effect is different for the two constituents, while Lorentz supposes them to be equal. The introduction of this hypothesis into the calculations of Van Loghem does not alter the general form of the results, but has the effect of giving expressions for the phase and the amplitude of the magneto-optic component which differ by a constant quantity and a constant angle from the old values. In this way the difference of phase discovered by Siasingh is explained; and from the observed value of this difference of phase the ratio between the intensity of the Hall effect for the displacement and conduction currents can be calculated, and then from observations of the amplitude the value of each of these can be found. From the calculations made by the author it appears that the values thus obtained are of the same order as those got by direct observation of the Hall effect, if we suppose that the specific resistance of metals for periodic currents of extreme rapidity is greater than for continuous currents. This view is further supported by other calculations which have been made by the author. The Paper concludes with a comparison between the above theory, and the theories propounded by Thomson, G.L. hammer, and Drude.

A PIONEER LIGHTING MANUFACTURER—ELLIOTT P. GLEASON.

ALL developments of lighting are evolutionary, the one springing from the other; oil, gas and electricity succeeding and supplementing each other in an orderly and sequential manner. Electricians have had a great deal to learn from gas practitioners, and it is not too much to say that some of those who have been most helpful in promoting the adoption and perfection of the electric light have been those who first learned the secrets of illumination as workers and inventors in the gas field. Prominent in this small group of pioneers who bridge the passage from the old art to the new is Mr. Elliott Perry Gleason, a portrait of whom from a recent photograph we take great pleasure in presenting in this issue of *THE ELECTRICAL ENGINEER*. Born at West Moreland, N. H., on June 27, 1821, on a farm, and one of a family of eleven children, Elliott had his own way to make in the world with little but inherited virtues and shrewdness to help him. He soon developed into the indispensable mechanic and tinkerer around the old homestead, keeping all the primitive machinery of furrow and dairy in order. To help satisfy his young ambition, he was apprenticed to a tinsmith, but gave up the craft in ill health. Then he tried clerking it, and found his way to Providence, R. I., where he obtained a clerical position and at once started inventing.

As one looks back on some of those early inventions, many of which remain in use to this day, one realizes how much of steady cumulative effort and genius goes to the building up of an industry. Among these notable displays of his inventive ability while still a young man, were the following:—process of lettering on glass; the American check gas burner; suspended cigar lighter; gas torch; scroll die for thread cutting, pipe fitter's hooks; tip separate from pillar in gas burner (before 1850, most burners were made wholly of cast iron); regulating gas burner; shade holder with elastic or flexible arms to yield with the expansion and contraction of the glass (before 1860, these holders were of ring or cast form and rigid). This taste for invention has never left Mr. Gleason, but is indulged with profit even to-day. Among the products of his prime, may be mentioned the regulating argand gas burner, which netted large sums of money.

Mr. Gleason formed a partnership in Providence, with Messrs. Mooney & Shaw, and went on inventing and manufacturing appliances for the better use of gas; but in 1861 he came to New York, continuing and enlarging the business; and in 1871 he founded the now celebrated house of E. P. Gleason Mfg. Co. In 1872, he built a large six story factory at the corner of Houston and Mercer streets, and in 1883 he extended it by adding a wing of the same size as the original building. In 1876 he began the etching of glass, a class of work that had before been done chiefly in France and England. His glass ventures soon assumed great magnitude, and in 1881, he bought glass works in Greenpoint, Long Island. Since that time, several buildings have been added, so that to-day the factory is the largest etching and sand blasting establishment in the country, while the glass works proper are the largest in New York State.

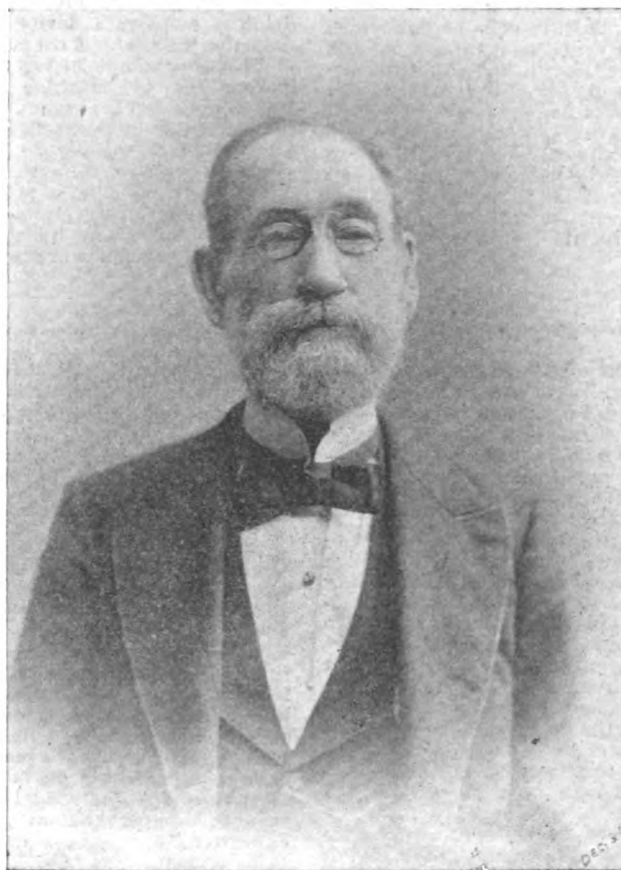
All this will have indicated the alert and progressive character of the man, and will have accounted for the readiness with which he lent all the means at his command to forward the commercial success of the electric light when it appeared on the scene. Not only did he make experimental glass at his glass works, and novel metal parts at his New York factory, but he took the keenest interest in all the remarkable devices and developments of those exciting pioneer years. Through his co-operation, the late J. B. Fuller, of the old Gramme-Fuller dynamo, set up in the Gleason factory, in 1877, his two-armature machine, with water

running through to keep it cool; and it was not for want of patience, generosity and assistance on Mr. Gleason's part that the apparatus failed of its purpose. But the electric art was advancing meantime, with many a hint and pointer from friendly gas men of Mr. Gleason's type, and in 1883, Mr. Gleason found it necessary, in order to meet the demand for the improvements often due to his suggesting or devising, to begin the adaptation and manufacture on a large scale of electric fittings, or the production of the now universal combined electric and gas fixtures, whose real originality and value to the art is not yet realized in the slightest degree even by those who benefit most from them. Down to the present time, Mr. Gleason's house has remained a very large manufacturer of electrical fittings, specialties and glassware.

Nor did this exhaust the energies of a really remarkable man, for whom success in one line is only an immediate inducement to advance the arts in some other branch of industry. Mr. Gleason has at Seneca Falls a big knitting mill, the second largest in the State. He has also a large fire apparatus and pump works in the

same busy village, carried on by the Gleason & Bailey Mfg. Co., who have a worldwide business in these lines, the outgrowth of an industry going back to 1840. The New York headquarters are under the same familiar roof in Mercer street, and Mr. Gleason gives this department of his affairs the same unremitting attention as all the others.

It will be seen that the subject of this brief sketch is not a young man, as years go; but in every other respect he holds his own with any of his juniors. Employing at least a thousand hands, he knows the names of most of them, and can greet them cordially and intimately on the chance meeting of the moment. He is around his different enterprises all the time, and in more ways than we can here tell, typifies the restless, acute, indefatigable, successful New England inventor, whose genius lies at the base of so much that is finest and best in American achievement in the arts and sciences. Without such men, no art can advance; with their aid any art will make giant strides to perfection.



ELLIOTT P. GLEASON.

DANGER FROM TELEGRAPH POLES NEAR THE TRACK.

A correspondent of our contemporary, the *Railroad Gazette*, writing on the above subject says:—

But for the good judgment exercised by the trainmen of one of our fast freights in abandoning their schedule and "feeling their way" we should have had a disastrous wreck from this cause on the night of Nov. 5. I have long felt that the gigantic poles erected along the tracks of our trunk lines, and daily growing weaker, were a constant menace, to ignore which was to invite disaster. While it may not be practicable, at the present time, to force all poles back, as you suggest, we can and should insist upon rigid inspection and the renewal of any pole showing signs of weakness.

THE FIRST DIRECT CONNECTED ARC LIGHT STATION AT CHICAGO.

On the night of Dec. 17 the Mutual Electric Light & Power Co., of Chicago, started in commercial operation its station equipped with direct driven series arc light machines. This is the first station in the world operated in this manner, and as such marks an era in arc lighting. The dynamo of the Brush type has a capacity of 125 lights and is direct connected to a Willans compound engine. This combination was exhibited at the World's Fair last year and attracted wide attention at the time. The new station is built on the most approved modern lines, and Brush-Adams arc lamps are employed.

1. For description see *THE ELECTRICAL ENGINEER*, Dec. 26, 1894.

SOCIETY AND CLUB NOTES.

A. I. E. E. MEETING.

At the 92nd meeting of the Institute held at 12 West 31st St., Dec. 19, a paper was presented by Mr. Ludwig Gutmann, of Chicago, "On the Production of Rotary Magnetic Fields by a Single Alternating Current."

In the absence of the author the paper was read in abstract and the discussion opened by Dr. M. I. Pupin and continued by Messrs. Wolcott, Kennelly and Burnett.

At the meeting of council in the afternoon the following Associate Members were elected.

F. S. Blackall, N. Y. City, Representative Crocker-Wheeler Elec. Co., 126 Liberty St., N. Y. City; G. DeRyckere, Professor of Electrical Engineering, Grand University, Belgium; residence, Boulevard Frere Orban 18; Harry E. Dey, 342 Tenth street, Brooklyn, N. Y.; G. W. Graham, Secretary, Interior Telephone Co., 203 Broadway, N. Y.; residence, 163 Hicks street, Brooklyn, N. Y.; Vance Lane, Manager and Supt. Construction, Nebraska Telephone Co., Omaha, Neb.; H. A. Lardner, Instructor in Electrical Engineering, State College, Pennsylvania; P. R. Moses, Student of Electrical Engineering, Columbia College, N. Y.; residence, 46 West 97th street, N. Y.; Charles A. Pratt, Electrical Engineer, The Independent Elec. Co., 39th street and Stewart Ave., Chicago, Ill.; Louis Privat, Electrician, Cicero Water, Gas and Electric Light Co., Oak Park, Ill.; John C. Shedd, Professor of Physics and Applied Electricity, Marietta College, Marietta, Ohio, residence, 512 Fourth street, Marietta, Ohio; G. H. Vander-slice, Westinghouse Electric and Mfg. Co., Pittsburg, Pa., P. O. Box 911.

The following Associate Members were transferred to Membership.

Henry G. Reist, Designing Engineer, General Electric Co., Schenectady, N. Y.; E. W. Trafford, Electrical Engineer, Richmond Railway and Electric Co., 104 N. 7th St., Richmond, Va.; Henry Jackson, Telegraph Superintendent and Engineer, The Lancashire & Yorkshire Railway Co., Horwich, Bolton-le-Moors, Lancashire; W. F. B. Rouquette, Proprietor Rouquette & Co., 74 University Place, N. Y.; Fritz Uhlenhaut, Jr., Electrical Engineer, Philadelphia Traction Co., Philadelphia, Pa.

A Committee was also appointed by Council to consider the question of an Index of Electrical Literature. The Committee is as follows: Prof. F. B. Crocker, Chairman; Messrs. Edward Caldwell and A. E. Kennelly, Professors W. M. Stine and Geo. D. Shepardon.

BROOKLYN ELECTRICAL SOCIETY.

A meeting of the Brooklyn Electrical Society was held in the auditorium of the Edison Electric Illuminating Co., in Brooklyn, last Thursday evening, and was well attended by members and their guests. The lecturer of the evening was Mr. George B. Muldaur, who spoke of "Elementary Electrical Principles," illustrating his remarks by black-board sketches. A course of lectures will be given during the winter.

The society is in excellent condition, is in the hands of enthusiastic and capable officers, and is rapidly growing in strength and usefulness.

LEGAL NOTES.

W. U. MUST ISSUE NEW STOCK TO REPLACE LOST.

In the Minnesota supreme court Judge Mitchell has handed down a decision in the important case of Jonas Guilford vs. the Western Union Telegraph company. The plaintiff in this case, Jonas Guilford, was the son of Asa Guilford, who died in 1882. At the time of his death he was the owner of \$35,000 worth of the stock of the Western Union Telegraph company, but the stock certificates could not be found, neither have they been presented to the defendant company for transfer or to secure the payment of dividends. Jonas Guilford brought suit to compel the Western Union company to reissue the certificates of stock, and in its answer the defendant set up the provision that no stock that had been lost or stolen could be reissued unless a bond for double the amount was furnished the company. Jonas was unable to furnish this bond and the Supreme Court has already twice ruled against him on the ground that the courts of this state have no jurisdiction over a foreign corporation. Now, after a lapse of twelve years the court assumes such jurisdiction and directs the company to reissue the stock without the indemnity bond being furnished by Jonas and upon failure to so issue the stock, judgment for the amount claimed will be entered against the company. The court took the ground that the stock certificates must have been lost, as no other claim had been made during the twelve years.

LETTERS TO THE EDITOR.

UNDERGROUND WORK.

Permit me to say to the readers of your journal that I have taken up the subject of *Underground Conduits and Conductors for all Classes of Electrical Service*.

It is my desire to produce a book on this subject that will not only give a faithful historical statement of what has been accomplished in this country in this department of electrical development, but also to give the results of experience and a clear statement of the best practice of the day, for the information and guidance of those who are yet to make investments in underground construction and for city authorities in formulating rules and permits.

In order that I may complete this work quickly and have it, when done, of the highest degree of practical efficiency, I will thank all persons who have had experience, or who feel an interest in the subject, to make suggestions to me as to the plan and scope of the work and also to indicate what information, based on experience or technical information, they are willing to place at the service of the public through the medium of my book.

ALLEN R. FOOTE.

P. O. Box 685, WASHINGTON, D. C., Dec. 6, 1894.

LITERATURE.

Electrical Transmission of Energy And Its Transformation, Sub-division And Distribution. By Gisbert Kapp. Fourth edition revised and enlarged. Illus. 445 pp. Cloth. D. Van Nostrand Co., N. Y. Price, \$3.50.

Kapp's book has been for several years a standard authority on the subject of electrical power generation and use, and has been rendered the more valuable by its systematic revision from time to time. As many of our readers are aware, when the first edition of it came out, the direct current had a practical monopoly of such work. To-day, the conditions are changing, and they will continue to change so as to give more prominence and importance to the alternating current in its various forms. These later developments enter into the survey of Mr. Kapp, and his book thus becomes a comprehensive review of the whole subject. This last edition is like its predecessors, worthy a place in the library of every electrical engineer.

MUNICIPAL ELECTRICAL INSPECTION IN NEW YORK.

At a meeting of the New York Board of Estimate and Apportionment, held Wednesday, the 19th inst., a request was made by F. E. Moore, representing the Chamber of Commerce, for an appropriation for the purpose of appointing inspectors to supervise the placing of electric light wires for light, heat and power in all buildings in this city. An appropriation was partly provided for, under the additional amount allowed for the Fire Department for the ensuing year.

The purpose of the appropriation is in accordance with an act passed in the New York State Assembly, February 16, 1892, entitled "An Act to Consolidate Into One Act and to Declare the Special and Local Laws Affecting Public Interest in the City of New York, in so far as the same relates to the Fire Department of said city." The portion of that Act which relates specifically to the matter, as brought up at the meeting, is under Section No. 517½, which calls for a "Bureau of Fire Alarm, Telegraph and Electrical Appliances," and furthermore provides for the appointment of inspectors to look after the installing of all electrical wires for furnishing light, heat or power in any building in this city.

BIDDING FOR A CALIFORNIA FRANCHISE.

A party who wanted a street railroad franchise in Berkeley having bid therefor the munificent sum of \$12, the Town Trustees proposed to refuse the proposition, when the attorney for the applicant read from the State law to prove that the award of the franchise to the highest bidder is mandatory. We presume it is so in the sense that the franchise cannot be awarded to anyone else than the highest bidder, but to assume the law means that anyone may apply for a street railroad franchise anywhere, and if he bids more for it than anyone else, the local government must necessarily accept his bid and afterwards pass an ordinance awarding him a franchise, is to assume a most monstrous thing. It would be tantamount to saying that the people have lost all control over their streets, which may be taken by any railroad corporation that wants them. Berkeley's Trustees should not be persuaded by any such cheap bluff.—Oakland, Cal. Enquirer.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED DECEMBER 18, 1894.

Alarms and Signals:—

Circuit Closer for Burglar Alarm Systems, A. Stromberg, Chicago, Ill., 530,976. Filed May 24, 1894.

A spring contact which opens the circuit by moving the covering of an opening to be protected.

Burglar Alarm System, A. Stromberg, Chicago, Ill., 530,976. Filed May 24, 1894.

A plug and socket are so associated with the movable portion of the opening to be protected that the plug must be removed from the socket in order that the opening may be uncovered. The contacts then close and complete the protective circuit.

Danger Signal and Lock for Switches, G. E. Edwards, Brantford, Conn., 531,025. Filed June 16, 1894.

Signal Lamp for Electric Railway Cars, C. H. Baker, Detroit, Mich., 531,146. Filed Apr. 24, 1894.

The act of reversing the car reverses the lamp.

Electric Safety Appliances for Railroads, E. L. Orcutt, Somerville, Mass., 531,214. Filed Nov. 2, 1893.

The object of the invention is to automatically stop the train if the rails of the track ahead are broken, the switch or drawbridge is misplaced or a car or other obstruction is on the rail.

Electric Block Signaling System, A. J. Wilson, Port Chester, N. Y., 531,384. Filed May 14, 1894.

Conductors, Conduits and Insulators:—

Electric Conduit, T. T. La Pointe, J. H. Flanagan & C. A. Thompson, New Haven, Conn., 530,951. Filed Nov. 23, 1893.

Relates to method of making joints between pipes forming the conduit.

Distribution:—

Electric Converter, F. C. Priestly, San Francisco, Cal., 531,005. Filed Feb. 16, 1894.

A construction of the core by which the coils may be readily removed for repair.

Dynamos and Motors:—

Controlling Device for Elevators, A. B. See & W. L. Tyler, Brooklyn, N. Y., 531,070. Filed Aug. 24, 1894.

Claim 1:—

An electric elevator provided with a normally open circuited driving shunt wound motor, a controller mounted on a car, connections for closing the circuit when the controller is operated and gradually increasing the speed of the motor, and a circuit closing device on the elevator for gradually varying the resistance of the field magnet circuit.

Electro-Metallurgy:—

Apparatus for Electric Heating, Smelting and Separating, J. W. Woodfolk & J. C. Wharton, Nashville, Tenn., 531,143. Filed Dec. 12, 1893.

Employs a hollow electrode through which the material is fed surrounded by a vessel through which water circulates.

Process of and Apparatus for the Production of Caustic Alkali, C. T. J. Vautin, London, Eng., 531,235. Filed Jan. 11, 1894.

Consists of the treatment in a fused condition by electrolysis of a salt of sodium or potassium forming the electrolyte, upon a molten bath of lead alloying with the sodium and potassium, and not affected by the fused caustic alkali, the said metal forming the cathode of the electric circuit; conversion into a caustic alkali of the sodium or potassium from its alloy with the molten cathode, by the treatment of a part of the cathode in situ by water. *Process of Extracting Metals from Sulphide Ores, etc.*, V. Englehardt, Vienna, Austria-Hungary, 531,169. Filed Jan. 21, 1893.

Lamps and Apparatuses:—

Incandescent Electric Lamp Socket, C. H. Balsley, Connellsville, Pa., 531,238. Filed Apr. 20, 1894.

Measurement:—

Electric Meter, T. Bruger, Bockenheilm, near Frankfort-on-the-Main, Germany, 531,153. Filed June 22, 1894.

An alternating meter. The shunt coil is in parallel with the circuit and the main coil in series.

Miscellaneous:—

Sign Advertising Machine, O. P. Briggs and W. R. Patterson, Chicago, Ill., 531,018. Filed Jan. 26, 1894.

A pointer adapted to automatically trace the characters or words as they are formed by the successive illumination of lamps and switches operated to conform with the movements of the pointer.

Coupler for Organs, C. Wales, Detroit, Mich., 531,077. Filed Feb. 10, 1894.

Electric Belt, L. F. Fuller and A. J. Taylor, Norfolk, Va., 531,109. Filed Aug. 8, 1894.

Apparatus for Purifying Liquids, J. T. Harris, New York, 531,118. Filed Nov. 18, 1892.

Employs a magnet to act upon the diamagnetic particles such as organic matter, silica, alumina, etc., which are then conveyed away from the purified liquid. May also be employed with the direct action of the current.

Method of and Apparatus for Purifying Liquids, J. T. Harris, New York, N. Y., 531,183. Filed Oct. 17, 1890.

Presents to the body of water to be purified magnetic poles of different polarity in such a manner that the impurities are successively and diamagnetically repelled in the direction opposite to the movement of the stream.

Railways and Appliances:—

Trolley Wire Finder, F. F. & W. S. Meyer, Newark, N. J., 530,954. Filed Mch. 14, 1894.

Hand Operating Mechanism for Electric Locomotives, A. W. Mitchell, Boston, Mass., 530,956. Filed Apr. 14, 1893.

A mechanism for operating the controller and brake by the same handle. Employs a rack meshing with gear wheels attached to regulator and brake shaft.

Brake and Power Controller for Electric Cars, A. W. Mitchell, Boston, Mass., 531,268. Filed Jan. 22, 1894.

Mechanism for operating the controller and brake by a single movement. *Guide for Trolley Wheels*, W. H. Dickerhoof, Cincinnati, Ohio, 531,291. Filed July 23, 1894.

A pair of pivoted arms so arranged that as soon as the pressure of the trolley wire is removed from the trolley the guide arms rise in place and guide the trolley wheel back to the wire.

Telegraph:—

Finger Board Telegraph Key, E. E. Mullinix, Burlington, Kan., 530,957. Filed July 31, 1894.

A key board which imparts to the circuit closer the proper impulses which make up the dot and dashes of the ordinary Morse alphabet.

Sounder, F. F. Howe, Marietta, Ohio, 531,188. Filed Jan. 15, 1894.

An improved adjustable sounder contact; may be used as a repeating or a local sounder or as a relay.

Telephones and Apparatus:—

Telephone Transmitter, D. A. Kusel, St. Louis, Mo., 531,194. Filed Aug. 6, 1894.

A simple form of carbon transmitter.

Telephone Speaking Tube System, T. C. Wales, Jr., Boston, Mass., 531,078. Filed Apr. 7, 1894.

Employs a number of circuits having a common source of current with a call wire connected by branches to the circuits and source of current.

Trade Notes and Novelties AND MECHANICAL DEPARTMENT.

WESTERN NOTES.

OMAHA, NEB.—The city lighting contract has been let again for five years from Dec. 1, 1894, at the rate of \$34 per arc per annum, Philadelphia schedule.

QUINCY, ILL.—The Empire Light and Power Company has been incorporated by T. L. Faucett, Harry O. Chandler and John P. Wheeler. The capital stock is \$25,000.

VALPARAISO, IND.—A telephone franchise has just been granted to Mr. J. H. McGill of Chicago, who will at once equip a complete telephone exchange.

THE ATCHISON, KANS., Street Railway and Light Co.'s electric road was formally opened on December first last, on which occasion a banquet was given to General Manager Mr. B. F. Waggener, by the enthusiastic citizens.

MR. EUGENE HOLCOMB for many years identified with electrical interests on the Pacific Coast, and more recently with the Portland, Oregon General Electric Company, stopped in Chicago for a few days last week.

ELECTRIC ROADS FOR CICERO, ILL.—A franchise was granted by the Cicero town board on the 15th inst. giving the Ogden St. R. R. Company the right to build and operate trolley lines on all the principal streets of the town, except those already occupied by other lines. It is stated that the Yerkes syndicate will control the road. Mr. E. A. Cummings is interested.

A USEFUL BOOKLET.—The Standard Electric Company, Chicago, have recently issued a "Station Hand Book," giving full instructions for the installation and operation of their apparatus, from unpacking the machinery to the starting of the plant. While the pamphlet is primarily intended for the benefit of the Standard Electric Company's patrons, it contains so much valuable information, tables and diagrams, that it cannot fail to be of great interest and value to those operating other makes of electrical machinery.

THE JENNEY ELECTRIC MOTOR COMPANY has abandoned the idea of removing from Indianapolis, but will, as soon as practical, get into larger buildings, probably building on quite an extensive scale as their increasing business will justify. The company now has 120 men at work who, in some departments, are working overtime. Of late they have received a number of orders for the largest generators they manufacture, one to go to a large plant to be erected at Cleveland, O.

CHRISTMAS DECORATIONS.—Scarcely a person passes the Adams Street office of the Chicago Edison Company without pausing to admire a large American flag hung in one of the office windows. It is made up of 500 1 C. P. miniature lamps, the three colors being correctly represented by the red, white and blue bulbs. The white bulbs being of frosted glass gives a very pleasing effect, and the whole arrangement is, to say the least, beautiful. The idea of constructing this novel display originated with Mr. Chas. Holmes, the purchasing agent of the company, while Mr. J. H. Goehst, their superintendent of construction, carried out the idea in a successful manner.

PHILADELPHIA NOTES.

THE EDISON ELECTRIC LIGHT CO., OF PHILADELPHIA, is seeking to secure further franchise privileges from the city, and is going through a series of lively negotiations on the subject.

SOUTHERN NOTES.

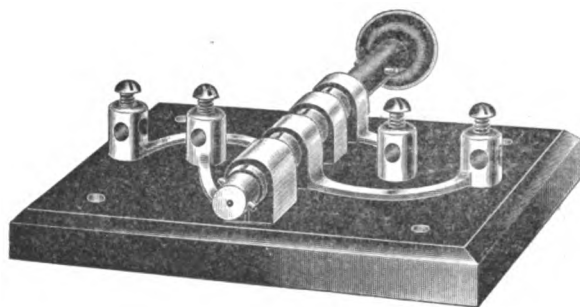
MARTINSBURG, W. VA.—The Kilbourn knitting mills are making some important additions to their plant, including an electric light equipment.

MR. J. W. GODFREY AND HABIRSHAW WIRE.

It is natural that the movements of any one so prominently connected with the insulated wire trade in this country as Mr. J. W. Godfrey has been, should be followed with considerable interest by electrical people everywhere. The recent announcement in our columns that he had resigned his position as General Manager of the New York Insulated Wire Co. after a connection of eight years, was received with no small amount of surprise, as the success achieved by him in building up the reputation of "Grimshaw" wire had made an intimate association in the public mind between them. But changes will and do happen, and Mr. Godfrey now bids fair to add another chapter to his record as a man of exceptional honor and ability by taking up the products of the India Rubber & Gutta Percha Insulating Co. These goods have been on the market many years, and Mr. W. M. Habirshaw has brought them to the front, by the application of his long experience as a chemist, electrician and manufacturer. Under the arrangement now entered into, Mr. Godfrey assumes charge of the selling department, and will handle all the celebrated "Habirshaw" specialties, in wire, cable, tape, etc. He will be assisted by Messrs. F. W. Harrington and J. B. Olsen, who are also well known to the trade throughout the East and West. Mr. Godfrey has opened a selling department at Room 88, 15 Cortlandt street, to which it is requested all orders may be sent.

NEW KELSCH ARC LAMP HANGER BOARD.

THE Underwriters' rules governing the installation of arc and incandescent lighting are becoming more stringent as the use of such lights increases, and perhaps justly so, in view of the fact that the majority of fires caused by electricity are due to faulty installation rather than to any inherent defects of the apparatus itself. One of the recent rules refers to hanger boards for arc lamps, and specifies that such boards must be absolutely fire proof, and must be provided with a switch which allows the



NEW KELSCH ARC LAMP HANGER BOARD.

lamps to be completely cut off from the circuit and not merely shunted. Mr. R. S. Kelsch of the Chicago Edison Company has recently devised a hanger board which not only complies with all of the Underwriters' requirements, but has several novel features. It has been fully approved by the City of Chicago, as well as by the Board of Underwriters.

The hanger board, which is shown in the accompanying engraving, consists of a rectangular plate of marbleized slate with four binding posts, two for the line and two for the lamp terminals. The two outside posts are the prescribed 8 inches apart, and are for the mains, the lamp being suspended from the two inside posts. In the centre of the board are a series of four brass sleeves which are part of the line and lamp terminals. These sleeves are so spaced that when a hard rubber plunger, carrying spring brass ferrules is pushed to one side or the other, the ferrules either complete the circuit from the mains to the lamp or entirely separate the main and lamp circuits, without however opening either. All the metal parts have ample carrying capacity, so as to stand 50 amperes without even getting warm, and the brass contact ferrules being split and made of spring brass insure absolute contact at all times. At a test made by the Board of Underwriters, it was found that with as many as five arc lamps connected to the lamp terminals (in series) the switching device showed no sparking when the lamp loop was cut in or out.

The binding posts are drilled from two sides so that the line wires may enter from either direction. Instead of the lamp being suspended by wires from the lamp posts, the binding screws may be removed and a brass suspension rod, properly threaded, screwed into the post; in fact, this is the method adopted by the Chicago Edison Co. for all in-door lamps. The board is covered by patent dated October 9th, 1894, and is being handled by the Chicago Edison Company, who have bought the entire rights to the invention, and who are prepared to fill orders promptly, as they will at all times carry a large stock of this indispensable accessory.

ELECTRICITY IN THE BANNER MINE, OROVILLE, CAL.

An interesting electric mining installation has been in operation for some time past near Oroville, Butte County, California, at the Banner Mine of the Development Syndicate, Major Frank McLaughlin, general manager. The particular interest applying to this installation is due to the fact that all the power required for both the mining and the milling of the ore, is electric. The power station is about two miles distant from the mine and mill, and water is obtained from the Feather River, under 112 feet head, operating two Pelton water wheels, which, in turn, drive two 85 H. P. direct current, 500 volt generators.

The power supplied by the generators is utilized in driving motors operating separately a ten-stamp gold mill, a rock breaker, a 10' by 20' Rand air compressor, and two pumps on the 800 and 500 feet levels of the mine, of the Knowles vertical triplex, single-acting type, one with plungers of 6 1/4" diameter by 8" stroke, and the other of the same type, with plunger of 5" diameter by 8" stroke. The hoisting works are also operated by an electric motor, and the mine and mill lighted from the power wires. Owing to lack of water for power, the hoist has thus far only been operated intermittently; but a large bulkhead has been built recently which will store sufficient water to allow of its operation at all times in connection with the other apparatus.

The following letter attests the success attending the operation of this plant:—

DEVELOPMENT SYNDICATE, LTD.

Oroville, Cal., October 26, 1894.

Thomas Addison, Esq.,

Manager General Electric Company, San Francisco, Cal.

My Dear Sir:—

I take great pleasure in stating that the Electric Power Plant installed by your Company at the Banner Mine, for operating the Mill, Rock-Breaker, Lighting System, Air Compressor and the Pumps on the 800 and 500 levels, works perfectly and to our entire satisfaction.

I take advantage of this opportunity to acknowledge with thanks the constant courtesy, vigilance and ability of your representatives, and to congratulate both you and them on the successful installation of the electric plant in the face of natural obstacles and mechanical difficulties that were seemingly insurmountable.

(Signed)

FRANK McLAUGHLIN, Manager.

TELEPHONE SYSTEM FOR THE INTERIOR DEPARTMENT.

Bids were opened by the Chief Clerk of the Interior Department for the construction of a telephone exchange system for the Department of the Interior, on Dec. 18, 1894. The following is a list of the bidders: Rhyce & Marean, Washington, D. C., \$5,151.01; time 75 days. Western Telephone Construction Co., Washington, D. C., \$8,165.76; time 90 days. Gilliland Telephone Co., Chicago, Ill., \$5,598.37; time 90 days. Gerson Electrical Co., Philadelphia, Pa., \$3,996; time 90 days. Bid submitted without guaranty. Viaduct Manufacturing Co., Baltimore, Md., \$3,557.50.

THE DAY IT WAS LAID.

The Central Electric Company have placed on the market a Leclanché porous cup, having the date on which it was made stamped on the outside. Every one using these will appreciate this as it is frequently a great convenience to be able to determine why a cell fails or to know that it has failed much sooner than it should under ordinary circumstances. Knowing the date of its manufacture, it is an easy matter to determine whether the difficulty rests with the porous cup itself.

FIXTURES WANTED FOR GOVERNMENT BUILDINGS.

The Treasury Department is inviting proposals until 2 o'clock, January 3, 1895, for manufacturing and placing in position in the United States buildings at Cedar Rapids and Fort Dodge, Iowa, Lowell, Mass., Sheboygan, Wis., and Sioux Falls, S. Dak., combination gas and electric light fixtures.

Additional particulars may be obtained by addressing C. S. Hamlin, Acting Secretary of the Treasury, Washington, D. C.

ELECTROLYTIC COPPER.

It comes from sundry sources that the electrolytic plant of the Boston & Montana company at Great Falls, which was originally expected to produce 800,000 pounds of copper per month is actually producing more than twice as much and at a very slight increase in cost.

MR. J. E. DUVAL, contractor and construction engineer, formerly of New York, and now having headquarters at Charlotte, N. C., has been unusually successful in this Fall's business. During the last sixty days he has installed three of the new Loomis slow speed generators—two 250 light and one 850 light; besides this he has installed three smaller dynamos. Trade is booming among the cotton mills in the South and Mr. Duval seems to be getting his share of the lighting business.

THE BOLTON CAR SEAT.

Messrs. G. B. Bolton and F. H. Henry, of 28 Court street, Boston, are the proprietors of a peculiar form of car seat, for which a number of advantages are claimed. They are individual seats and one person can occupy but one. By their peculiar arrangement it is claimed that two more persons can be seated in an eighteen-foot car than with the ordinary continuous seats, and this without crowding, as ample room is allowed where it is most essential, namely, at the shoulders. The barriers or divisions between seats, while serving the same purpose as division arms, do not lessen the seating capacity in the slightest degree.

It is a well-known fact that, while division arms are very desirable, many roads have discontinued using them on account of passengers being injured by sitting heavily upon them. With these seats an injury of this kind is said to be impossible. The shape of the backs is such that the occupant is held firmly yet comfortably in the seat, and is not lurched sideways when the car starts or stops suddenly. As vacant seats are readily seen the moment a passenger enters the car, the conductor will not be obliged to continually call out "Move up," "Move down," or "Make room for one more." The cushions are made with springs, are detachable, and can be readily taken out and cleaned. The seat frame is made in skeleton form, so that all dust and dirt can easily fall to the floor. They are said to be more economical than continuous seats, as the upholstery is held much more firmly, and the passenger, once taking a seat, holds it, and is not continually moving along to make room for others, and thus wearing the covering. Being made in sections, in case of damage to any of the parts, they can be re-covered or re-upholstered at a small expense, when in a continuous seat it is often necessary to re-cover the entire seat, although it may be damaged in one or two places only.

SALES OF W. R. FLEMING & CO.

W. R. Fleming & Co. 203 Broadway New York, and 620 Atlantic Ave., Boston, representing the Harrisburg Foundry & Machine Works, Harrisburg, Pa. report the following sales for the past few weeks: Ideal self-oiling engines and Harrisburg tubular boilers for the American Surety Building N. Y. City two (2) 150 h. p. Ideal engines direct connected to two 100 k. w. dynamos, one 80 h. p. direct connected to 50 k. w., and two 50 h. p. d. c. to two 30 k. w. dynamos; for Edward J. Berwind's residence, N. Y. C. one 50 h. p. Ideal engine; Norwalk Street Ry. Co., South Norwalk, Conn., one 150 h. p. for electric railway service; export to South Africa one 100 h. p. tandem compound Ideal engine; Yugo Isabel & Co. Guantanamo, Cuba one 80 and one 40 h. p. engine; Northport Electric Light Co. Northport N. Y. two 100 h. p. engines and two 100 h. p. Harrisburg boilers with complete steam plant work; for "Albermarle" Hotel, N. Y. C. two 50 h. p. engines direct connected to two 25 k. w. multipolar dynamos; Fairfield Copper Co. Monroe, Conn. one 20 h. p.; Castle Square Theatre Boston, Mass. two 150 h. p. and one 25 h. p. direct connected to two 100 k. w. and one 25 k. w. dynamos; Keith's Theatre, Boston, three 150 h. p. direct connected to three 100 k. w. dynamos; Union St. Ry. New Bedford, Mass. one compound engine of 500 h. p. and two 250 Harrisburg boilers and complete steam plant for railway service (2d order); Carpenter & Tremaine, Campbell, Me. one 20 h. p. Ideal engine; Amherst College, Amherst, Mass. one 80 h. p. engine; the Belknap Motor Co. Portland, Me. one 30 h. p. Ideal engine; the Hartford City Gas Light Co., two 30 h. p. engines; the L. Candee & Co. New Haven, Ct. one 150 h. p. direct connected to two 50 k. w. multipolar dynamos; the "Bolkenhayn" apartments, N. Y. C. one 130 and one 50 h. p. direct connected to 25 and 75 k. w. multipolar dynamos; Wharton & Williams, Newark, N. J. one 50 h. p. engine; O. B. Stillman, Boston, one 20 h. p. Ideal engine; General Electric Co., Schenectady, N. Y., one 50 h. p. for direct connecting to their 25 k. w. multi-polar dynamo; one 200 h. p. Harrisburg tubular boiler (3d order) for H. W. Johns Mfg. Co. South Brooklyn N. Y.; one 200 h. p. Harrisburg boiler (3rd order) for H. W. Johns Mfg. Co., South Brooklyn, N. Y.

THE CENTRAL ELECTRIC CO.'S CATALOGUE SUPPLEMENT.

The Central Electric Co., of 163-175 Adams street, Chicago, have issued an elaborate supplement to their general catalogue, in preference to waiting for the next regular issue. Many new goods have been added to the company's stock, and prices and general quotations have so materially changed as to make such a step advisable.

The supplement contains over one hundred pages, including a revised discount sheet, and much will be found upon its pages of importance to every one directly or indirectly interested in the electrical industries. Many new and improved devices are shown and the supplement, aside from its own interest, adds greatly to the value of the company's already large catalogue.

Some idea of the scope of the supplement may be gained from the fact that the index alone covers three closely printed pages of

two columns each—from "Alarms" to "Xntric switches"—and includes all the latest things pertaining to electric construction and supplies.

The pamphlet is well printed and illustrated.

DIVIDENDS.

The Commercial Cable Company has declared a quarterly dividend of $1\frac{1}{4}$ per cent., payable January 2.

The Westinghouse Electric & Manufacturing Company has declared a quarterly dividend of $1\frac{1}{4}$ per cent., payable January 2.

NEW YORK NOTES.

"P. S.," who advertised recently in our columns for a position as electrician may hear of something to his advantage if he will communicate with this office.

THE NEW YORK STANDARD CONSTRUCTION CO., of 97 Nassau street, this city, have secured a contract to build the Batavia Street Railroad operating upon the streets of Batavia, N. Y. and to Horseshoe Falls, about $7\frac{1}{2}$ miles.

MR. AUGUSTUS NOLL has resigned his position as electrical engineer of the New York Electrical Equipment Co., and with Mr. Howard A. MacLean is about to start in business for himself as an electrical contractor. He will restrict himself to that, doing no experting work.

BLOOMFIELD, N. J.—Ground has been broken for a silk mill in Bloomfield. East Orange parties are erecting the mill, and it will be used for the manufacturing of silk dress goods. It is located on Orange Street near the Watsessing station of the Delaware, Lackawanna and Western Railroad. Electricity will be used as a motive power in the factory.

THE MANHATTAN ALARM COMPANY has been organized to manufacture and sell machinery and mechanical devices, instruments and apparatus for fire alarm and signaling purposes; capital, \$20,000. Directors—Albert S. Williams, Herbert N. Hansen, William H. Thitchener, John J. Dwyer, and Frank L. Ryan of New York City.

THE C. & C. ELECTRIC COMPANY has recently shipped an electric mining plant to Maiz Bros., Monterey, Mexico, consisting of a 40-H. P. electric hoist; 25-H. P. Root blower driven by electricity, together with several motors for various uses in the interior of the mine. The power is to be furnished by a 100 H. P. C. and C. generator, also shipped with the order.

MR. FRED'K. BATHURST, E. E., who has been actively engaged in electrical work in this country, sailed for England last week, to assist in the development of the interior conduit industry there. Mr. Bathurst has had considerable electrical experience both sides of the water. He was at one time with Ayrton & Perry and also with Woodhouse & Rawson in the days of their prime. In America he has chiefly been associated with the General Electric Co. He has also done some newspaper work, and his recent interview with Mr. Edison, quoted in these pages, will be remembered. Of late, Mr. Bathurst has made a thorough study of interior conduits, and is well posted on that important subject.

NEW ENGLAND NOTES.

BANGOR, ME., has created the position of Superintendent of Wires, the office to pay a salary of \$300 per year.

BELL TELEPHONE STOCK.—On Dec. 12 the American Bell Telephone Company declared a regular dividend of 3 per cent., with an extra dividend of $1\frac{1}{2}$ per cent. Since the Berliner decision published in the ENGINEER last week the Bell stock has dropped from over 200 to around 190.

THE W. J. DAVIS ELECTRIC CO. has been formed at Pittsfield, Mass., by Mr. W. J. Davis who for some five years past has been the superintendent of the motor department of the Stanley Mfg. Co. The new concern is to occupy the south wing of the Berkshire Brewing Association Building, and will employ about 20 hands to start with.

THE AMERICAN ELECTRICAL WORKS, of Providence, R. I., have issued a Christmas card to their friends, which exhibits their wonted cleverness and felicity. In the centre, is the portrait of their best friend, in colors, within a wrapper. Opening the wrapper one finds a mirror, and, of course, sees one's own face. Printed on the card are expressions of seasonable good will, all of which will be echoed by the legion of friends and admirers of the Works.

Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.



(July-
1894)
leer.

(July-
1894)
leer.

leer.

